PAVING THE ROAD TO COLLEGE: IMPACTS OF WASHINGTON STATE POLICY ON IMPROVING EQUITABLE PARTICIPATION IN DUAL CREDIT COURSES

By

Havala Hanson, M.A.

A Dissertation Submitted in Partial Fulfillment of the Requirements

for the Degree of

Doctor of Philosophy

in

Statistics and Policy in Education:
Interdisciplinary Studies

University of Alaska Fairbanks

December 2019

APPROVED:

Dr. Amy Vinlove, Committee Chair
Dr. Julie McIntyre, Committee Member
Dr. Barbara Adams, Committee Member
Dr. Christopher Mazzeo, Committee Member
Dr. Kenneth Wong, Committee Member
Dr. Amy Vinlove, Director
School of Education
Dr. Kinchel Doerner, Dean
College of Natural Science and Mathematics
Dr. Michael Castellini, Dean, *Graduate School*

Abstract

This dissertation evaluates early impacts of a state policy to increase participation in dual credit courses in Washington state through subsidizing the cost of college credits for underrepresented rural and low-income students, and through extending eligibility to earn dual credit to students in grade 10. This study evaluates both aspects of the policy, with emphasis on the impacts for underrepresented rural and low-income students, students of color, and English learners. It employs quasi-experimental designs to estimate the impact of the policy on intended outcomes. The study finds mixed early impacts of the policy. While no effects were found for students attending schools near the cutoffs for eligibility for tuition subsidies, promising evidence emerged on the policy's impact on participation in dual credit among students in grade 10. The findings can provide policymakers with early evidence of the policy's effects, identify places where implementation may be strengthened, and serve as a blueprint for ongoing monitoring of the policy's impact and similar evaluations of dual credit policies nationwide.

Table of Contents

List of Figures

List of Tables

List of Appendices

Dedication

I dedicate this dissertation to my husband, Rino Avellaneda, who patiently sacrificed our time together to provide space for me to craft this work. For the many, many nights and weekends spent at home in silence, for accepting unambitious vacations with family when hoping for world adventures, for putting up with piles of equations scattered all over the house, this is for you. It's a humble gift, but let it be the first pages of a new chapter of our lives together that transcends all that came before.

Acknowledgements

I would like to thank my chair, Amy Vinlove, and my committee members, Barbara Adams, Julie McIntyre, Christopher Mazzeo, and Ken Wong, for their feedback and guidance throughout the past several years. I would like to thank Education Northwest for allowing me to use their facilities to analyze the data and for the flexibility to juggle a full-time job while taking classes and writing a dissertation many years in a row. I am grateful to the Washington Office of Superintendent of Public Instruction for providing data used in this dissertation and to the University of Alaska Fairbanks Institutional Review Board for approval to conduct this research (Appendix A). Finally, I acknowledge Terri Akey for her persistence in nudging me to earn my doctorate and putting in place the structures that made it possible to do without pausing my career. Getting here was mostly torture, but it was worth it.

1.0 Research Motivation and Background

While college enrollment and educational attainment have increased substantially over the past generation, so too has the imperative for postsecondary education and training to secure family-sustaining careers in the modern economy (Burning Glass Technologies, 2014). Although educational attainment has risen across the board, large gaps persist across groups from different racial/ethnic and socioeconomic backgrounds (Snyder, de Brey, & Dillow, 2019). This can contribute to disparate access to economic opportunities throughout life, which are compounded by high child poverty rates and exponential increases in the cost of postsecondary education (Alston, 2018; College Board, 2014; Complete College America, 2014).

Education agencies recognize the return on investment for educating all students is safer, healthier, and more productive communities (Global Partnership for Education, 2018). In response, state governments and state and local education agencies have led the charge in expanding opportunities for high school students to get a head start on postsecondary education by earning college credit through dual credit and dual enrollment courses. Promising evidence of dual credit and dual enrollment course-taking on increasing postsecondary enrollment, persistence, and completion motivates the urgency to facilitate pathways toward postsecondary education (U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, What Works Clearinghouse, 2017a). In addition, the United States has stagnated in educational attainment relative to other developed nations. Despite doubling the percentage of 25 to 34-year-olds with a postsecondary degree since 1981 (from 23 to 48 percent), the United States fell from third to tenth among developed nations in this measure (Organization for Economic Co-operation and Development, 2016). Dual credit and dual enrollment programs are a strategy to support the United States in keeping pace with educational attainment levels in other developed countries.

However, a drawback of locally-initiated policies and programs is that variation in policies and funding can lead to uneven opportunities and outcomes. Traditionally, students from rural areas, from racially/ethnically and linguistically diverse backgrounds, and from low-income families or communities have been underserved by all options for obtaining postsecondary education credit while in high school (Gilbert, 2017; Museus, Lutovsky, & Colbeck, 2007; Pretlow & Wathington, 2013; Pierson, Hodara & Luke, 2017; Davis, Smither, Zhu, & Stephan, 2017). Although they fall short of increasing access and equity in participation nationally, state governments have policy levers to expand enrollment and increase equity in dual credit and dual enrollment within their states. Washington state, with a series of policies and funding targeted at underrepresented populations described above, has attempted to achieve representative participation in dual credit and dual enrollment courses.

One approach to reducing barriers to obtaining postsecondary credentials is to give students an opportunity to begin achieving them while in high school at little to no cost for students and families. This strategy, often referred to as "accelerated learning options" typically provides students with several ways to earn college and high school credit simultaneously (National Conference of State Legislatures, 2014; Western Interstate Commission for Higher Education, 2006). Accelerated learning options include credit for proficiency, such as Advanced Placement (AP), International Baccalaureate (IB), Cambridge Program International (CP), dual enrollment courses taken on a college campus, dual credit courses taken at a high school, and career and technical education preparation (tech prep) courses that award credit at career technical colleges.

Dual credit and dual enrollment options, called College in the High School (CHS) and Running Start in Washington state, respectively, concurrently enroll high school students in college level courses. Students who successfully complete these courses earn both high school and college credit that can count towards both a high school diploma and a college degree. Students wishing to take dual credit or dual enrollment courses often must meet certain criteria, such as a grade level or grade point average requirement and passing a placement test or prerequisite course sequence.

1.1 Definitions of Policy Components

Accelerated learning options refer to credit-based secondary to postsecondary transition programs that permit high school students to earn college credit for coursework completed during high school, either through proficiency tests (e.g., AP and IB tests) or through enrollment in postsecondary-level courses (dual credit, dual enrollment, and tech prep) (Bailey & Karp, 2003).

Dual credit courses are known as College in the High School courses in Washington state. They are taught at a high school by high school teachers who are adjunct faculty at the community college or university sponsoring the credit, or in partnership between a high school teacher and college professor. Students earn college and high school credit upon successful completion of the course.

Dual enrollment courses are known as Running Start courses in Washington state. They are taught by college faculty on a college or university campus and are open to both college and high school students. Upon successful completion of the course, students earn both high school and college credit.

House Bill 1546, hereafter referred to as HB 1546, was signed into law in 2015 (H.R. 1546, 64th Leg., Reg. Sess., 2015). It funds teacher training, curriculum, technology, examination fees, textbook fees, and other costs associated with offering dual credit courses to high school students. Targeted funding was provided to underrepresented students and the high schools that serve them. The bill also extended eligibility to earn college credit in CHS courses to students in grade 10. Previously, only students in grades 11 and 12 were eligible.

Underrepresented students are identified in HB 1546 as those who live those who live or attend high school further than 20 miles from the nearest college campus that offers Running Start courses, those who attend high schools with 300 or fewer students, and those who are eligible for free or reduced-price lunch and attend a school with at least 50 percent of students who are eligible for free or reduced-price lunch. In addition, this dissertation considers students of color and English learners as underrepresented.

1.2 Significance of the Study

While a growing body of research exists on participation in and the effects of dual credit and dual enrollment programs, this dissertation will provide unique contributions. To maximize the potential of policies to expand dual credit and dual enrollment programs, a clear understanding of who they serve and their effects on targeted populations is needed. This dissertation intends to inform future investments in accelerated learning options that can enhance their benefits for individuals, communities, education systems, and, ultimately, social and economic systems through increasing educational attainment (for example, by reducing a mismatch between available jobs and the skills and credentials of the local labor force).

First, few studies have examined the impact of specific state policies concerning dual credit or dual enrollment programs. Information about the potential effects of these policies can generate evidence to refine them and sustain their funding. This information can also support the efforts of many Washington state agencies and organizations that have goals for dual credit and dual enrollment participation, such as the Office of Superintendent of Public Instruction, the Washington Student Achievement Council, the Washington STEM Network, the Road Map Project, educational service districts, and higher education institutions. Many of these agencies and organizations provide direct supports or funding to students, schools, and/or districts that could benefit from a deeper understanding of dual credit and dual enrollment course-taking.

Second, little is known about the specific dual credit and dual enrollment courses students take, how this varies among different student groups, and how dual credit and dual enrollment course-taking patterns predict subsequent educational performance and attainment. Understanding these patterns can, for example, help school and college counselors advise students on what courses to take and help them prepare for those courses. It could also provide evidence to direct resources to expanding capacity to offer those courses.

This dissertation is organized in the following way. Chapter two discusses findings from the literature on the impacts of accelerated learning option course-taking on secondary and postsecondary student outcomes. It reviews research on dual credit and dual enrollment policies. Throughout, it identifies the strengths of existing research. It concludes with a discussion of how the present study adds new knowledge to the body of literature on dual credit and dual enrollment programs.

Chapter 3 provides an overview of dual credit and dual enrollment policy in Washington state. It includes a discussion of seminal legislation over the past 30 years and presents data on how the most recent policy, the central focus of this dissertation, has been implemented.

Chapters 4, 5, and 6 present the study findings. Chapter 4 describes accelerated learning option course-taking patterns among Washington high school students, featuring comparisons among student groups. Chapter 5 discusses the impact of HB 1546 on college in the high school course-taking in schools targeted by the policy using a regression discontinuity (RD) approach. Finally, chapter 6 describes the impact of HB 1546 on CHS course-taking among grade 10 students using a comparative interrupted time series design. Each of these chapters describes the analytic sample and methods, presents findings and contextualizes the results within the policy goals.

The final chapter discusses the relevance of the findings to the field and their implications for practice and policy. In addition, it identifies areas for future research.

2.0 Literature Review

A large volume of research exists on dual credit and dual enrollment programs. The bulk of this literature assesses through quantitative research designs these programs' influence on high school graduation and postsecondary enrollment, and progression towards and completion of a postsecondary degree. A smaller portion of this research examines, often through qualitative approaches, how participation in dual credit and dual enrollment courses influences students' academic and social behaviors, awareness of the administrative systems and processes required to matriculate and persist in college, and their perceptions of themselves as learners. Finally, some studies describe program features and local and state policies related to dual credit and dual enrollment. These studies sometimes highlight potential costs and benefits of dual credit and dual enrollment programs for local and state economies and education agencies.

The following literature review discusses these three themes from research on dual credit and dual enrollment programs. Within themes, studies with conclusions based on the strongest methodological designs are presented first. Studies are described in the order of the quality of their methods, the rigor of peer review prior to publication, and the quantity of evidence from other studies to support their findings. After discussing these themes, the principal gaps and limitations of existing research are identified.

2.1 Promising Effects of Dual Credit and Dual Enrollment Programs on College Enrollment, Persistence, Academic Performance, and Degree Attainment

The overwhelming majority of research on dual credit and dual enrollment programs has examined their relationships with academic performance and educational attainment outcomes at the secondary and postsecondary education levels. Generally, this research has focused on dual credit and dual enrollment programs' influence on high school graduation, college enrollment, progression through college, and degree completion. Findings suggest that earning college credit in high school has a positive influence on these outcomes, which extends to students from a variety of backgrounds, even those who are not considered academically high performing.

The strongest evidence of this connection comes from two randomized control trials of early college high schools (Berger, et al., 2013; Edmunds, et al., 2017). Early college high schools are partnerships between high schools and colleges that enable students—typically those from historically underserved populations—to earn an associate's degree or up to two years of college credit concurrently with a high school diploma by spending most of their last two years of high school on a college campus. The studies found statistically significant positive impacts on students' aspirations for attending college, high school academic performance, and the likelihood of high school graduation, college enrollment, and college degree completion. One of the studies found additional positive impacts on students' readiness for college-level coursework, high school attendance, and accumulation of credits in college (Edmunds, et al., 2017). The other found additional positive effects on academic performance in college (Berger, et al., 2013).

Despite strong evidence of their success, early college high schools represent a small fraction of dual credit and dual enrollment programs, with fewer than 300 schools nationwide. They also feature program components that are uncommon among other types of dual credit and dual enrollment opportunities, such as comprehensive student supports and a cohesive curriculum (Berger, et al., 2013; Zinth, 2016a). However, three quasi-experimental studies that met the U.S. Department of Education's What Works Clearinghouse standards with reservations examined the impacts of the dual credit and dual enrollment programs typically found in schools throughout the country (U.S. Department of Education, Institute of Education Sciences, National

Center for Education Evaluation and Regional Assistance, What Works Clearinghouse, 2017b). These studies established a control group from observational data using propensity score matching and found evidence that supports the positive effects of dual credit and dual enrollment programs on college enrollment, degree attainment, and/or college credit accumulation (An, 2013; Giani, Alexander, & Reyes, 2014; Struhl & Vargas, 2012). One recent study used the percentage of students enrolled in dual credit in a student's high school, an indicator of the level of implementation of dual credit, as an instrumental variable to predict the student's dual credit participation when estimating the effects of taking dual credit courses (Miller, et al, 2018). After accounting for selection bias through this approach, the study found no effect on high school graduation, modest positive effects on college enrollment, completion, and time to degree.

Several other studies used propensity score matching to establish a relationship between dual credit and dual enrollment programs and positive secondary and postsecondary education outcomes (Allen & Dadgar, 2012; Blankenberger, Lichtenberger & Witt, 2017; Radunzel, Noble & Wheeler, 2014). These studies failed to establish baseline equivalence between students in the treatment group and their matched peers. Nonetheless, many of these studies provide promising evidence to suggest that the positive effects of dual credit and dual enrollment programs could be widespread across different contexts throughout the nation, extend to students who are historically underrepresented in postsecondary education, and apply to other postsecondary outcomes beyond those assessed in the more rigorous studies described above. For example, Grubb, Scott, and Good (2017) found that students who enrolled in dual enrollment courses in Tennessee were 3.4 times less likely to take developmental skills courses in college and 2.5 times more likely to graduate with an associate's degree within two years than their matched peers. Another study found dual credit enrollment decreased time to degree completion for Utah students from underrepresented groups, including students of color, English learners, and low-income students, which resulted in measurable household and state-level savings (Haskell, 2016).

Recent evidence suggests that dual credit programs and policies may have differential effects for underrepresented students. Taylor (2015) found dual credit from community colleges had positive effects on college access and completion for all students, but the effects were less pronounced for students of color and students from low-income families. Another study showed that traditionally advantaged student groups, such as White students and student from high-income families, experienced gains in college academic performance and completion after participating in dual-credit programs (Miller, et al, 2018). The effects of dual-credit participation for less advantaged groups were sometimes negative—relationships that were often explained by these students' lower levels of academic preparation for advanced coursework as measured by grade 8 assessment scores.

Finally, several studies provide descriptive and correlational evidence of dual credit and dual enrollment programs' relationship to positive secondary and postsecondary education outcomes. These studies lack a counterfactual group to establish causal evidence of dual credit and dual enrollment programs' effects. However, they often include large, representative samples, such as an entire state's public high school students. Many of these studies found that students who participated in dual credit or dual enrollment courses were more likely to enroll in college immediately after high school graduation (Bautsch, 2014; Cowan & Goldhaber, 2015; Karp, Calcagno, Hughes, Jeong, & Bailey, 2008; North & Jacobs, 2010; Swanson, 2008; Wang, Chan, Phelps, & Washbon, 2015), persist past the first year of college (Karp, Calcagno, Hughes, Jeong, & Bailey, 2008; North & Jacobs, 2010; Wang, Chan, Phelps, & Washbon, 2015), accumulate more college credits (Bautsch, 2014; Karp, Calcagno, Hughes, Jeong, & Bailey, 2008; North & Jacobs, 2010; Wang, Chan, Phelps, & Washbon, 2015), and complete a degree (Ganzert, 2010; Shapiro, Dundar, Ziskin, Yuan & Harrell, 2013; Swanson, 2008; Wang, Chan, Phelps, & Washbon, 2015). In addition, one study noted that dual credit and dual enrollment course-takers took less time to earn a two- or four-year degree (Southern Regional Education Board, 2011).

On the other hand, there is some evidence that the benefits of earning college credits during high school are driven only by students who take courses on a college campus. A couple of studies found that students who take dual credit courses in their high school are equally as likely as students who did not take any dual credit or dual enrollment courses to enroll in college and complete a degree. In comparison, students who took dual enrollment courses on a college campus were more likely to enroll in and complete college than either of the other groups (Borden, Taylor, Park & Seiler, 2013; Edwards, Hughes & Weisberg, 2011).

Findings on college performance varied. Many studies found that students who earned college credit in high school had higher grade point averages in high school than students who did not (Bautsch, 2014; Ganzert, 2010; Jones, 2014; Karp, Calcagno, Hughes, Jeong, & Bailey, 2008; North & Jacobs, 2010; Wang, Chan, Phelps, & Washbon, 2015) but one found little to no difference in college grade point average between the two groups (Crouse & Allen, 2013). While one study found enrollment in developmental or remedial college courses to be less likely among students who participated in dual credit or dual enrollment courses than for other students (Bautsch, 2014), another concluded that there were no differences in pass rates of final courses in writing, mathematics, and Spanish sequences among students who took prerequisites in high school and those who took them in college (North & Jacobs, 2010). Further, descriptive analysis on changes in the academic preparation of dual credit students in New Mexico suggests that the typically superior academic aptitude of dual enrolment students can explain their lower rates of enrollment in developmental education classes in college and their tendency to graduate in less time than students who did not take dual credit courses (New Mexico Legislative Finance Committee, 2017).

In sum, a large body of research evidence suggests that dual credit and dual enrollment course-taking has positive effects on students' postsecondary education outcomes. However, only a small portion of this research establishes baseline equivalency between treatment and comparison groups needed to estimate a causal impact that is not driven by selection bias. These studies also frequently lack explanations for how and why these positive relationships exist, some of which is covered in other areas of research on dual credit and dual enrollment discussed in the next section.

2.2 Promising Results in Socio-emotional, College-knowledge, and Other Non-academic Postsecondary Education Readiness Outcomes

Relative to research on the relationship between dual credit and dual enrollment programs and quantifiable academic outcome measures, research on non-academic outcomes is limited and less current. However, an understanding of how dual credit and dual enrollment programs are related to these non-academic outcomes can shed light on how these programs influence postsecondary success and educational attainment. Though small, this body of evidence agrees that dual credit and dual enrollment programs can positively influence students' academic engagement and aspirations, knowledge about college, and perception of themselves as a learner.

One motivation for offering dual enrollment courses is to improve student engagement by leveraging college campuses to offer a more diverse selection of courses than high schools could afford to do. Programs promote high school student motivation and engagement in their learning through more interesting classes, the opportunity to attend them on a college campus in certain dual enrollment program models, and the experience of higher expectations (Lerner & Brand, 2006). A few studies based on surveys or interviews of dual enrollment students found that they typically enjoy their participation in dual enrollment programs, find it useful and motivating, and are generally satisfied with their experience (Kanny, 2015; Robertson, Chapman & Gaskin, 2001). One survey of more than 600 Utah students who took dual enrollment courses found that 96 percent ranked their experience as “good” or “excellent” (Peterson, Anjewierden & Corser, 2001).

Dual enrollment students who attend classes on a college campus benefit from the college experience. Students who take classes on a college campus learn about and become accustomed to the college environment, as they master logistical issues such as locating the registrar’s office and the bookstore. This experience can help students feel more comfortable and less intimidated when they attend college after high school (Berger, et al., 2009; Kuh, Gonyea, & Wlliams, 2005; Pretlow & Wathington, 2014; Tinto, 1993; Tobolowsky & Ozuna, 2016). In addition, students can take advantage of on-campus resources, such as academic and career advising, libraries and technology labs (Edwards, Hughes, & Weisberg, 2011; Bragg, Kim, & Rubin, 2005). On-campus experiences along with knowledge of available supports can assist students with their transition to college (Zimmerman, 2012).

The dual enrollment model offers students the opportunity to try out the role of being a college student and develop some of the skills needed for postsecondary success (Karp, 2012). Putting students on a college campus can foster a sense of responsibility, as students begin to see themselves as college material (Allen, 2010; Burns & Lewis, 2000; Edwards, Hughes &

Weisberg, 2011; Wechsler, 2001). By participating in courses on a college campus, postsecondary education becomes an achievable goal. For example, one study surveyed 304 rural students in Kansas to find that participation in dual credit programs had a positive and statistically significant relationship with students' aspirations for educational attainment (Smith, 2007). A majority of respondents believed that their dual enrollment course was more rigorous than their high school courses and that their participation encouraged them to attend college.

In general, this evidence on dual credit and dual enrollment programs demonstrates that students and faculty have positive perceptions of the programs. It also points to college campus-based programs as the more promising strategy to maximize the immediate and longer-term benefits of earning college credits while in high school. The college experience, difficult to replicate within the high school, prepares students for both the emotional and academic rigors of college life. At the same time, this model could exclude some students from participating if they are unable to get to the college campus. This is one of many trade-offs discussed in the literature around dual credit and dual enrollment policy. Key areas of this literature are summarized below.

2.3 Studies Documenting Program and Policy Components

A number of studies feature scans of dual credit and dual enrollment policies and program features. These studies typically rely on document analysis to describe common components of programs and compare implementation across a variety of contexts. At times, they include analysis of interview and survey data to identify common concerns and promising practices. The following section summarizes common components of dual credit and dual enrollment programs discussed in this literature, highlighting the mechanisms policymakers typically leverage to influence dual credit and dual enrollment implementation. These include setting criteria for student participation, regulating quality assurance practices, defining rules for course offerings, and funding the programs.

Student participation. It is important to ensure that students are academically and emotionally prepared to take college-level coursework. Thirty-seven of 47 states responding to a nationwide policy survey reported that they have student eligibility requirements to participate in dual credit and dual enrollment courses (Borden, Taylor, Park & Seiler, 2013). The most common state-level requirement was that students be in at least grade 11. Programs also often have eligibility requirements that exceed state requirements, including minimum scores on the SAT or ACT, class rank, and high school grade point averages (Thomas, Marken, Gray, & Lewis, 2013; Kim, 2008). Thomas and colleagues (2013) found that 63 percent of a nationally representative sample of dual credit programs have their own eligibility requirements. Promising practices for preparing students for college-level work include enrolling them in basic academic skills courses, integrating academic supports into dual credit and dual enrollment courses rather than having students seek support on their own, and enrolling dual enrollment students in college success courses that provide them with information about the college and its programs and services (Edwards, Hughes, & Weisberg, 2011; Karp, Calcagno, Hughes, Jeong, & Bailey, 2008). In addition, studies have uncovered some promising practices for engaging underrepresented students and middle- or lower-achieving students to take dual credit and dual enrollment courses. Through interviews with students and faculty from several dual enrollment programs in California, researchers concluded that a strong career focus is important for motivating students since they could clearly see how their learning applied to their career goals (Edwards, Hughes, & Weisberg, 2011). The authors further concluded that hands-on technical dual credit and dual enrollment courses are appealing to a broad range of students, including those that struggle academically.

Quality assurance. Dual credit and dual enrollment credits do not always transfer when students matriculate into college, especially at selective, private, and out-of-state colleges (Borden, Taylor, Park & Seiler, 2013). Decisions not to allow dual credit or dual enrollment credit to transfer are linked to the variability in course content quality and academic rigor. To mitigate this, states have used accreditation policies, such as encouraging or requiring a national accreditor, the National Alliance of Concurrent Enrollment Partnerships (NACEP) (Borden, Taylor, Park, & Seiler, 2013). NACEP accreditation is designed to ensure quality standards for dual credit and dual enrollment courses. In addition, states have encouraged or required faculty professional development. College instructors often need help understanding how to connect with high school students and high school instructors often need help adapting their pedagogy to create realistic college-level expectations and experiences (Edwards, Hughes, & Weisberg, 2011). Ideally, the academic rigor should be "challenging yet manageable" so that students can believe that "college is for them, not beyond them" (Edwards, Hughes, & Weisberg, 2011, p.18). Finally, 37 of 47 states in a national survey reported that they require instructors of dual credit and dual enrollment courses to meet certain standards. Most often, these states require the criteria for selecting a qualified instructor for a dual credit or dual enrollment course to be the same as the criteria that the credit-granting institution uses to hire its own faculty (Borden, Taylor, Park & Seiler, 2013).

Course offerings. A 2013 study found that five states required public colleges to offer dual credit courses and 10 states required high schools to have college course options available to their students (Borden, Taylor, Park, & Seiler, 2013). The same study found that 26 states had some statewide requirements regarding the types of course that can or cannot be offered among dual credit courses. Some of these required that dual credit courses be offered only in core content areas. This policy is aligned with research that English language arts, mathematics, social studies, and science dual enrollment courses significantly influence students' access, transition, and persistence in postsecondary education (Giani, Alexander, & Reyes, 2014). The study authors further concluded that mathematics dual enrollment courses were positively associated with bachelor's degree completion. These courses may be more transferrable to programs of study when students matriculate, but they also limit the variety of options that could appeal to a broad range of students. Ideally, programs should offer courses that are likely to improve secondary and postsecondary outcomes while appealing to the students they are designed to serve (Edwards, Hughes, and Weisberg, 2011).

Funding. State policies governing dual credit and dual enrollment programs show the greatest interest in overseeing the financial aspects of administering those courses, rather than promoting a specific program model (Karp, Bailey, Hughes, & Fermin, 2004). Funding policy varies from state to state. As of 2013, 24 states reported that they offered direct funding for dual credit courses; 11 had funding provisions for specific programs, some had provisions that made dual credit courses free to all students, and others offered discounted tuition, fees, and books (Borden, Taylor, Park, & Seiler, 2013). The other 20 states where students bore responsibility for tuition, fees, or books made some provisions to subsidize those costs for targeted populations. An important question for states is whether dual credit and dual enrollment students should be dually funded (i.e., they receive full state funding as a high school student and full state funding as a college student). In a majority of states, schools and postsecondary institutions receive the same per-pupil funding for dual credit and dual enrollment students as they receive for their traditional students (Zinth, 2016b; 2016c). One state funded schools and colleges at a higher level than traditional students, and other states provided different levels of funding based on the type of dual credit or dual enrollment program the student enrolled in (Zinth, 2016b; 2016c).

2.4 Strengthening Existing Research

This dissertation aims to add value to the current body of research by examining three sets of research questions.

1. *Which accelerated learning option courses are Washington state students participating in? How does course participation vary for students who are or are not from underrepresented groups?*
2. *To what extent did HB 1546 funding impact participation in dual credit courses?*
3. *To what extent did HB 1546 change participation in dual credit courses for grade 10 students compared to trends from 2009/10–2014/15 for all students and for underrepresented students? To what extent did overall trends in dual credit course-taking change for students in schools eligible to receive funding through HB 1546 between 2015/16 and 2017/18 compared to students in schools that were not eligible to receive funding?*

Although three decades of research on dual credit and dual enrollment programs has accumulated evidence of these programs' potential to positively influence students' secondary and postsecondary achievement and attainment, several gaps remain. First, there is a lack of research that estimates the causal impact of dual credit and dual enrollment policy. The What Works Clearinghouse identified only five studies in a 2017 report from the U.S. Department of Education Institute of Education Sciences—two of which met standards without reservations using a lottery system to randomize students into early college high schools or a "business as usual" school, and the other three used propensity score matching. The remaining 57 studies either did not meet eligibility criteria for review or did not meet What Works Clearinghouse standards with or without reservations upon review. The reason most of these studies did not meet standards is that they failed to establish baseline equivalence between treatment and comparison groups. All of these studies measured dual credit and dual enrollment program, not policy, outcomes.

As noted, the preponderance of evidence on the outcomes of dual credit and dual enrollment programs is based on descriptive statistics, multiple regression, and propensity score matching analyses. In other words, conclusions are largely based on correlational evidence. Propensity score matching is considered one of the weakest quasi-experimental methods when used in isolation because it assumes baseline equivalence based only on available variables, which often omit important mediating factors for which data are unavailable (e.g., motivations and aspirations, parent education and income, etc.) and fall short of removing selection bias (King & Nielsen, 2019). Therefore, though evidence of dual credit and dual enrollment programs' effects is bountiful, it is typically insufficiently rigorous.

Another weakness of existing literature is that it frequently fails to evaluate the courses students take beyond the top-level category (for example, Advanced Placement, dual credit, dual enrollment). Therefore, little is known about how students' choices align with college admissions and core content requirements for most majors. This gap in knowledge leaves high school counselors with limited information with which to steer students toward a course of study and restricts the capacity of secondary-postsecondary partnerships to create curricular pathways that position students to maximize the benefits of dual credit and dual enrollment course-taking.

Finally, experimental and quasi-experimental analyses of the impact of specific dual credit or dual enrollment policies are absent from the literature. This leaves large gaps in information for state policymakers, state education agencies, and taxpayers. Feedback on the efficacy of policies to accomplish their intended purpose is needed to sustain and improve them. To date, this feedback is limited to descriptions of program inputs, such as the number of partnerships, educators, and students served by the policy, and outputs, such as the number of students earning college credits. Rarely, state policy studies include regression analysis to control for confounding factors (Miller, et al, 2018). Most existing research findings lack a counterfactual. That is, claims that results could have happened without the policy are indefensible.

This study addresses these concerns. With an emphasis on how accelerated learning option course-taking patterns vary for underrepresented students, it aims to identify potential areas to improve equitable access to accelerated learning options that can maximize financial and academic benefits to students at the postsecondary level. It expands upon quasi-experimental designs that rely on matching methods alone to assess a specific dual credit policy with regression discontinuity and comparative interrupted time series designs. The methods serve as a model to inspire future research to explore other pathways to examining the effectiveness of dual credit and dual enrollment programs and policies beyond propensity score matching.

In sum, this study aims to provide policymakers and education leaders with actionable information about the effectiveness of a policy to increase participation in dual credit and dual enrollment courses and improve equity in participation rates for underrepresented students. It further intends to inform national policy conversations around accelerated learning options.

3.0 History and Implementation of Accelerated Learning Options Policies in Washington State

Efforts to integrate secondary and postsecondary education have been made for nearly a century (Mayo, 2012). Recognizing that the last two years of high school and the first two years of college have a lot in common, ideas for systematically expanding access to postsecondary education have included middle college high schools (Middle College National Consortium, n.d.), a “6-4-4” school plan that included 6 grades of elementary school, 4 grades of junior high school (grades 7-10) and four grades of senior high school (11-14) that led to a high school diploma and an associate’s degree (Eells, 1940). Beginning in the 1950s, options to earn college credit through proficiency tests emerged. Students began earning credits through Advanced Placement (AP) in 1952 and through the International Baccalaureate (IB) program in 1968 (Katz, 2006; International Baccalaureate, n.d.). The current conceptualizations of dual enrollment and dual credit options arose in the 1970s and grew substantially over the past 40 years. Already in the 2010/11 school year, approximately 2 million students took dual credit or dual enrollment courses and 82 percent of high schools offered them (Thomas, Marken, Gray & Lewis, 2013). This represents an increase of 67 percent from the 2002/03 school year (Mangan, 2014).

In Washington state, dual credit and dual enrollment programs are a key strategy of the Washington Student Achievement Council Roadmap and Strategic Action Plans to reach the state goal of having at least 70 percent of Washington adults aged 25–44 holding a postsecondary credential (Washington Student Achievement Council, 2015). Likewise, it is a cornerstone of the Superintendent of Public Instruction’s agenda, as well as a key performance indicator in the state’s report card (Reykdal, 2017). This emphasis from educational agencies and organizations on dual credit and dual enrollment programs is reflected in nearly three decades of state policies to expand access and participation in these options. Legislation created the Running Start Program in 1990, establishing dual enrollment options statewide for high school students (Wash Rev. Code § 28A.600.300-400, 1990). In 2009, the legislature began requiring the Office of Superintendent of Public Instruction (OSPI), the state's education agency, to report annual participation in Running Start, College in the High School, tech prep, IB, and AP courses, disaggregated by race/ethnicity, gender, and receipt of free or reduced-price lunch (Wash Rev. Code § 28A.600.280, 2009).

The remainder of this section discusses the principal elements of Washington's accelerated learning options, and the specific policies and associated funding mechanisms that have been introduced during the past decade. It further situates these policies in the conceptual framework that forms the basis of the present study's research questions and analytic approach.

3.1 Washington State Accelerated Learning Options Policies

Two policies govern Washington state's standards and funding for dual credit and dual enrollment programs—The Launch Year Act (Wash Rev. Code § 28A.230.140, 2011) and the Academic Acceleration for High School Students (Wash Rev. Code § 28A.320.195, 2013), which later appropriated funding to develop dual credit programs through the Academic Acceleration Incentive Program (Wash Rev. Code § 28A.320.196, 2015). A third policy, HB 1546, expanded funding to the Academic Acceleration Incentive Program and allocated funding to the College in the High School program (Wash Rev. Code § 28A.600.290, 2015). Each of these policies is briefly described below.

The Launch Year Act. House Bill 1808 required Washington's public high schools and institutions of higher education to work toward increasing the number of dual credit courses offered to students (Wash Rev. Code § 28A.230.140, 2011). It also required institutions of higher education to develop a master list of postsecondary courses, known as "the Washington 45," that can be fulfilled at two- and four-year state colleges by taking recognized college-level proficiency examinations and meeting the qualifying AP, IB, and CI exam scores (Reykdal, 2018; Wash Rev. Code § 28B.10.053, 2012). This master list mitigates some of the issues related to credits earned in high school not properly transferring to postsecondary institutions upon matriculation (Gewertz, 2016; Modarelli, 2014). If students attend an in-state college, their credits are guaranteed to count.

Academic Acceleration for High School Students. In 2013, the Washington State Legislature expanded access to dual credit, especially for underrepresented students with the passage of House Bill 1642 (Wash Rev. Code § 28A.320.195, 2013), which encouraged placement in advanced courses based on standardized assessment scores. Funding was appropriated to develop and expand dual credit programs through a related policy, the Academic Acceleration Incentive Program (Wash Rev. Code § 28A.320.196, 2015). Half of the funding was allocated as incentive awards to schools based on a formula that incorporated current student enrollment in dual credit programs and half was allocated as one-time, small competitive grants ($2,000 to $10,000) to schools to encourage increases in dual credit opportunities. Recent outcomes from this grant program include increases in AP course offerings and exams taken, outreach to underrepresented student populations, training for high school counselors, professional development for K–12 teachers to engage with college faculty to increase CHS offerings and paying course fees for underrepresented and low-income students (Reykdal, 2018). This policy addresses some common concerns about dual credit and dual enrollment programs. For example, some studies have observed that dual credit and dual enrollment programs can widen gaps between low-income students and middle and high-income students when textbooks, fees, tuition, or transportation costs must be borne by students and families, and by extension due to disproportionate poverty rates, between students of color and white students and between English learners and native English speakers (Gilbert, 2017; Museus, Lutovsky, & Colbeck, 2007; Pretlow & Wathington, 2013; Pierson, Hodara & Luke, 2017; Davis, Smither, Zhu, & Stephan, 2017). Bias in academic counseling and course tracking can be reduced by requiring automatic enrollment in the highest-level course available according to standardized test scores and advancing them to the next highest level upon passing each course, which the Academic Acceleration for High School Students policy encouraged in 2013 and was amended in 2019 to require by the 2011/22 school year. Appropriating state funds to help students pay for the costs of dual credit and dual enrollment that are not covered by federal funding removes some barriers to participation of low-income students. In addition, state funding for secondary-postsecondary partnerships can assuage concerns over the quality and academic rigor of dual credit courses (Exby, 2014; Miller, Kosiewicz, Wang, Marwah, Delhommer, & Daugherty, 2017; Borden, Taylor, Park, & Seiler, 2013).

House Bill 1546. In 2015, the Washington State Legislature passed HB 1546, providing additional funding support for Running Start and CHS programs by expanding the use of existing Academic Acceleration Incentive Program funds to include textbook fees and transportation for Running Start students and expand Running Start and CHS offerings, prioritizing schools into three tiers: 1) rural schools, 2) small schools, and 3) schools with high percentages of low-income students. The legislation also appropriated $6.62 million for CHS tuition fees over the 2015–17 biennium to subsidize up to 10 credits (typically two courses) per eligible student each year. This amount supported 25,414 credits in 2015/16 (Washington Student Achievement

Council, 2016). District requests for subsidies to support 61,706 credits were approved for the 2016/17 school year. HB 1546 sets clear criteria for receiving funding. Tier 1 priority students receive funding if they are located at least 20 miles from a college offering Running Start courses. Tier 2 priority schools receive funding if they have 300 or fewer students enrolled in grades 9–12. Tier 3 priority schools have at least 50 percent of their students eligible for free or reduced-price lunch. Of note, once a school meets eligibility in the highest tier, it is removed from selection among lower priority tiers. In addition, for schools qualifying for funding based on the percentage of students who are eligible for free or reduced-price lunch, only students who are eligible for free or reduced-price lunch within the school can access funding. As noted above, HB 1546 also extended eligibility to participate in CHS courses to students in grade 10, although these students were not eligible for state-funded tuition support.

3.1.1 Implementation of HB 1546

Between 2015/16 and 2017/18, Washington subsidized 73,110 CHS credits earned by high schoolers in the state (table 3.1). This is equivalent to the number of credits required for 406 bachelor's degrees at the University of Washington (180 credits are required). At a rate of up to $65 per credit, this represents an annual state investment of up to roughly $1.5 million.

Since 2015/16, there has been a 64 percent increase in the number of schools awarded subsidies (from 68 in 2015/16 to 111 in 2017/18). Likewise, the number of subsidized CHS classes and credits awarded to these schools increased by 191 percent and 35 percent, respectively. However, the percentage of awarded credits that students took advantage of decreased after fully transitioning to the tiered award structure in 2016/17, resulting in a consistent number of credits being subsidized each year.

Although the number of subsidized credits has remained relatively constant, the distribution of CHS subsidies has changed. Prioritizing distant and small schools has increased the number of credits used in those schools from 11,027 in 2015/16 to 16,168 in 2017/18. At the same time, the number of credits subsidized in Tier 3 schools decreased from 8,889 in 2015/16 to 5,875 in 2017/18. This pattern could be policy driven. Under HB 1546, the state will subsidize up to 10 CHS credits (typically two semester-long classes) for each student in Tier 1 and Tier 2 schools. Low-income students in Tier 3 schools can only subsidize up to 5 CHS credits.

Two other groups of schools were awarded credits but are not the focus of this study. First, some schools were awarded credits for students who lived at least 20 miles from a college that offered Running Start although the schools they attended were ineligible under Tier 1. In addition, to transition to the new funding priorities defined in HB 1546, the legislature provided funding for schools that previously used Running Start funding to support CHS programs in 2015/16. These schools are excluded from the analysis for research question 2 but are otherwise included.

Table 3.1. College in the High School Courses Awarded and Used by Tier Status, 2015/16–2017/18

Funding Tier	School year	Number of schools	Awarded classes	Awarded credits	Credits used (%)
All	2015/16	68	378	47,729	25,414 (53%)
	2016/17	101	617	61,706	23,675 (38%)
	2017/18	111	721	64,752	24,021 (37%)
Tier 1 At least 20 miles from a college that offers Running Start	2015/16	9	30	1,824	962 (53%)
	2016/17	19	86	6,333	3,006 (47%)
	2017/18	22	103	8,100	3,162 (39%)
Tier 2 Less than 300 students attending regular high schools in the district and does not meet Tier 1	2015/16	28	178	15,800	10,065 (64%)
	2016/17	43	293	23,708	13,089 (55%)
	2017/18	48	308	27,813	13,006 (47%)
Tier 3 At least 50 percent of students eligible for free or reduced-price lunch and does not meet Tiers 1 or 2	2015/16	17	102	21,472	8,889 (41%)
	2016/17	27	137	21,962	5,384 (25%)
	2017/18	29	165	21,532	5,875 (27%)
School not eligible but student resides more than 20 miles from a college that offers Running Start	2015/16	11	19	2,302	1,568 (68%)
	2016/17	12	101	9,703	2,196 (23%)
	2017/18	12	145	7,307	1,978 (27%)
Funded in 2015/16 as a former recipient of Running Start subsidies and not eligible for subsidies subsequent years	2015/16	3	49	6,331	3,930 (62%)

Note: Regular high schools are designated by the Washington Office of Superintendent of Public Instruction. They exclude alternative schools, juvenile justice facilities, schools for students with special needs, and home services.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2015/16–2017/18.

3.2 Washington State's Implementation of Federal Policies Related to Accelerated Learning Options

Three federal policies have helped shape Washington state's accelerated learning options policy landscape. These include the Every Student Succeeds Act of 2015, Carl D. Perkins Career and Technical Education Improvement Act of 2006, and the Advanced Placement Test Fee program (U.S. Department of Education, 2016). Each policy's influence on Washington state's implementation of dual credit and dual enrollment opportunities is described below.

Every Student Succeeds Act. Dual credit course enrollment is an indicator of School Quality and Student Success in Washington state's plan to implement ESSA, the latest reauthorization of the Elementary and Secondary Education Act, which replaced the No Child Left Behind Act of 2001. As part of Washington's ESSA Accountability Measures, dual credit enrollment is one of several indicators used to track the closing of opportunity gaps for marginalized student populations. OSPI annually releases dual credit participation data, including disaggregated completion rates for each dual credit and dual enrollment program. The intent of including dual credit as an accountability measure is to improve equitable dual credit enrollment by identifying and promoting best practices gleaned from schools experiencing the most success in student achievement across all groups, particularly those facing historic barriers, such as students in isolated, rural schools and low-income students. This strategy may also surface the degree to which students experience unequal preparation for advanced course-taking throughout the state (Hanson, Bisht, & Greenberg-Motamedi, 2016).

Carl D. Perkins. The Carl D. Perkins Career and Technical Education Improvement Act of 2006 required the establishment of Programs of Study that provide students with career pathways that span secondary and postsecondary education. Washington state's Workforce

Training and Education Coordinating Board responded by adopting a strategy building on the existing foundation of tech prep dual credit that had established secondary-postsecondary articulation agreements around the state. Students enrolled in a secondary tech prep program who earned a B or better in their class earned college credits, transcribed at a community or technical college. Federal funding for tech prep dual credit through Carl D. Perkins was eliminated in 2011, though some partnerships in Washington endure (Reykdal, 2018).

Advanced Placement Test Fee Program. This program reduced fees for low-income students taking Advanced Placement exams (U.S. Department of Education, 2016). In 2016, a provision in ESSA eliminated federal funds to reduce test fees for low-income students in 2016. A substantially smaller amount was included into the Title IVa grant block in ESSA, creating a gap year in funding for the 2016/17 school year. A private-public partnership used one-time Title I funds and privately donated funds to allow all low-income students in Washington to take their dual credit-related exams for free (Reykdal, 2018). This was determined to be unsustainable at current state funding levels. It is unclear whether fees for AP, IB, and CI exams will be waived for low-income students in the future.

3.3 Conceptual Context for Accelerated Learning Programs and Policies in Washington State

Now that a foundational understanding of the historical dual credit and dual enrollment policy context has been established, I discuss each component of the conceptual framework, beginning with assumptions and external factors and concluding with long-term impacts. Table A1 in appendix A summarizes this discussion of the conceptual context. This section concludes with a description of how the study's research questions and proposed methodology intersect with this conceptual context.

Assumptions and external factors. Encouraging expansion of accelerated learning options relies on several assumptions and external factors. Foremost among them, it assumes that dual credit and dual enrollment are appropriate interventions to achieve the intended impacts on the socioeconomic health of individuals and, by extension, the state. Dual credit and dual enrollment programs are designed to decrease the time and costs required to earn a postsecondary degree or credential. The intervention recognizes that the cost of higher education has increased substantially while family purchasing power has not (Odland, 2012). At the same time, most careers require a postsecondary credential, even for entry-level positions (Burning Glass Technologies, 2014). In this context, high schools have an opportunity to use accelerated learning options to reduce the opportunity cost of earning a postsecondary credential so that it is within reach of a larger share of students.

Washington state's dual credit and dual enrollment policies also make assumptions about the capacities of existing secondary and postsecondary education systems. Limited funding for program and personnel development indicates that policymakers assume that these systems have the minimum resources required to create or expand dual credit and dual enrollment course offerings. These include faculty with the necessary credentials, existing relationships among decision-makers between secondary and postsecondary institutions that can be leveraged to build formal partnerships, and facilities and technology infrastructure that can support in-person and online dual enrollment courses. These policies further assume systems have the capacity and information needed to procure support among faculty and families, and prepare and recruit students to participate. This is critical when investing in dual credit and dual enrollment programs means that resources cannot be allocated to other initiatives.

Finally, Washington's dual credit and dual enrollment policies make some assumptions about the state's student population. Importantly, they assume that high school students are academically prepared and have the desire to take college-level courses, or that other policies will address achievement gaps or deficiencies in earlier grade levels. They acknowledge, but have limited means to address, conflicting commitments high school students have for work, family, or extracurricular activities that may prevent them from enrolling in dual credit or dual enrollment courses. This is especially relevant for Running Start courses that are held on a college campus outside of the regular school day.

Resources. State, school, college, family, and student resources contribute to the design and implementation of dual credit and dual enrollment policies and programs. The state contributes its ability to enact and fund policies. Funding can be tied to specific goals, such as HB 1546's priority funding to increase participation among underrepresented students and help small and rural schools provide equitable options to their students relative to those attending large urban schools. Schools and colleges contribute local resources to the implementation of dual credit and dual enrollment policies and programs. Their primary resource is the time of their faculty, counselors, and administrators. This includes providing professional development to faculty to help them teach students college-level material, time to develop partnerships, investments in earning credentials, and access to academic and career counselors. Schools and colleges also contribute the resources of their facilities, including access to libraries and technology, such as servers, learning management platforms, software, and videoconferencing, as needed.

Finally, families must be supportive of their children attending college-level courses, particularly if it requires students to secure their own transportation to a college campus. They may also often need to cover the costs of the courses, including discounted tuition, books, fees, and transportation. Further, they might have to make adjustments to allow their children to attend classes in the evenings, such as finding childcare for younger siblings or budgeting to account for the loss of a teenager's contributions to the household income.

The above barriers may limit HB 1546's impact on students eligible to receive subsidies. Implementation evidence suggests several schools that were eligible for CHS subsidies under HB 1546 were not prepared to implement a CHS program (table 3.2). Thirty-five percent of eligible schools (93 of 268) enrolled students in CHS courses in 2015/16. By 2017/18, half of eligible schools (128 of 256) enrolled students in CHS course.

Table 3.2. College in the High School (CHS) course offerings and subsidy recipients among regular high schools, by eligibility tier and school year, 2015/16–2017/18.

			Offered CHS courses		
HB 1546 eligibility status	**School year**	**Did not offer CHS courses**	**Did not apply for subsidies**	**Awarded subsidies**	**Total**
Tier 1:	2015/16	52	45	1	98
Distant schools	2016/17	45	5	43	92
	2017/18	36	9	46	91
Tier 2:	2015/16	62	18	1	81
Small schools	2016/17	52	10	15	77
	2017/18	47	11	19	77
Tier 3:	2015/16	61	28	0	89
High-poverty	2016/17	51	14	24	89
schools	2017/18	45	17	26	88
Ineligible	2015/16	59	107	0	166
	2016/17	56	112	0	168
	2017/18	45	116	0	161
Total	2015/16	234	198	2	434
	2016/17	204	141	82	426
	2017/18	173	153	91	417

Note: Regular high schools are designated by the Washington Office of Superintendent of Public Instruction. They exclude alternative schools, juvenile justice facilities, schools for students with special needs, and home services.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2015/16–2017/18

Strategies and activities. One of the primary strategies of Washington state's dual credit and dual enrollment policies is to increase the availability and quality of dual credit and dual enrollment programs. To advance this strategy, state policies allocate funding for the creation and expansion of partnerships between secondary schools and colleges, for high schools to create and expand dual credit and dual enrollment programs, and for underrepresented students to participate in accelerated options courses. Another key strategy is to increase enrollment in dual credit and dual enrollment courses. This involves providing funding for and requiring local and state education agencies to disseminate information to students and families about advanced course options; requiring that students be automatically enrolled in the most advanced course available based on standardized assessment scores and automatically advanced to the next highest course upon passing that course (Wash Rev. Code § 28A.320.195, 2013), and removing barriers to participation by covering costs to students not funded by federal or other sources and funding the expansion of offerings available to students (Wash Rev. Code § 28A.320.196, 2015).

Outputs and outcomes. Outputs are observable measures of completed activities. These include, but are not limited to, the number of eligible schools receiving funding, the amount awarded to each school, the number of secondary-postsecondary partnerships created or sustained, the number of secondary and postsecondary faculty teaching dual credit or dual enrollment courses, the number and variety of dual credit and dual enrollment courses offered, the number of students enrolled in dual credit and dual enrollment courses, and the number of underrepresented students enrolled in dual credit and dual enrollment courses.

Outcomes are the effects of the policy initiative within a given timeframe. Short- and intermediate-term outcomes can occur within 1 to 3 years, respectively. They include, but are not limited to, increases in enrollment in dual credit and dual enrollment courses and decreases in enrollment gaps for underrepresented students. Other outcomes may include improvements in academic engagement and rigor, as measured by grades, standardized assessment scores, attendance, and discipline records. Longer-term outcomes may include higher postsecondary enrollment and completion rates and lower rates of placement in postsecondary developmental English and math courses.

Long-term impact. For taxpayers, funding education is a long-term investment. The payoff from investing in dual credit and dual enrollment programs—if they achieve their short- and intermediate-term outcomes—comes years down the road in the form of a more highly-educated population. With higher degrees comes access to careers with family sustaining wages and industry-recognized credentials help the state's workforce meet its industries' needs. Higher earnings translate to higher state tax revenues, economic growth driven by increased consumption of goods and services, and improvements in public health and safety (Baum, Ma & Payea, 2013).

This dissertation focuses primarily on the outputs and outcomes included in the conceptual framework. It seeks to answer, "Did the policies have the effects they intended to?" The first research question explores patterns in the number and variety of courses students are enrolling in over time to elucidate any differences in the quantity and diversity of courses taken across different student groups. The other two research questions aim to isolate the impact of HB 1546's extension of eligibility to earn CHS credits to students in grade 10 and the impact of subsidized CHS tuition for underrepresented students on participation in CHS courses.

Along the way, the dissertation provides some evidence of the implementation of strategies and activities, such as the amount of credits funded in each tier, and estimates of treatment effects for different student groups that may suggest some external factors may or may not be barriers to achieving the intendent outcomes of Washington state's dual credit and dual enrollment policy.

3.4 Data Sources and Definitions of Key Predictors and Outcomes

To address the study's research questions, the analyses in chapters 4–6 use student-level data from OSPI from 2009/10 to 2017/18. The data include student demographic information, federal program enrollment, school enrollment, attendance, discipline, assessment, and course transcript files. Data on English learners from OSPI's Transitional Bilingual Instructional Program records dates from 2004/05 to 2017/18. This longer range of data enables identification of students who began school as English learners and reclassified as English proficient in early grades. All analyses in this dissertation rely on course transcript data submitted to OSPI. This includes approximately 65 million unique course records from 2009/10 to 2017/18.

In addition to student-level OSPI records, the study incorporates data from a number of public sources. First, it uses HB 1546 implementation data from public OSPI records to identify the schools that received CHS subsidies from 2015/16 through 2017/18, including which courses were approved for subsidies, how many courses and credits were allowed to be subsidized, and how many credits were claimed for subsidies. School-level public data from OSPI contributed information necessary to attribute values for student enrollment and the percentage of students eligible for free or reduced-price lunch that matched OSPI's data used to determine eligibility for CHS subsidies (Office of Superintendent of Public Instruction, 2019a). Public data also identified which colleges in Washington and neighboring states offered Running Start courses as well as physical addresses for high schools and colleges that enabled the documentation of distance in driving miles to a college that offers Running Start through the use of Google maps' driving directions feature. Finally, public data from the U.S. Department of Education National Center for Education Statistics Common Core of Data provided locale codes that categorized schools into four categories based the size of the communities they are located in and their distance to urban areas (U.S. Department of Education, National Center for Education Statistics, 2019a).

3.4.1 Definitions of Key Predictor and Outcome Variables

This study uses variables provided by OSPI and the public data sources cited above to define student groups and key indicator and outcome variables. The methods used to form student groups and construct variables are defined below.

3.4.1.1 Defining Student Groups

English learner status

Washington's population of English learners has grown steadily over the past decade, along with state and local efforts to accelerate time to proficiency and provide equitable, relevant, and rigorous educational opportunities to language minority students (Hanson, Bisht & Greenberg Motamedi, 2016). Recent studies show that high school student outcomes vary among different groups of English learner students in Washington based on when they were reclassified as English proficient (Hanson, Bisht & Greenberg Motamedi, 2016; Deussen, Hanson, & Bisht, 2017). While many nuanced categories of English learners have been defined in practice, this study defines three groups of students based on their English learner status and when they reclassified.

English learner status throughout their enrollment history in Washington state public schools categorizes them into three groups. Current English learners were classified as an English learner at any point between grades 9–12. They include "newcomer" English learners who enrolled in United States public schools for the first time in high school and students who were classified as English learners between kindergarten and grade 8 and did not reclassify as English proficient before grade 9. Former English learners were classified as an English learner between kindergarten and grade 8 and reclassified as English proficient prior to grade 9. The number of students correctly identified as former English learner students is more accurate for later cohorts who have up to 14 years of observable records, and less accurate for earlier cohorts, with as few as 6 years of observable records. Data on English learner status that begins in 2004/05 allows for the classification of former English learners back to at least grade 3 for students expected to graduate between 2013/14 and 2017/18. In Washington, it takes 3.8 years, on average, for a student in classified in kindergarten to reclassify as English proficient (Greenberg Motamedi, 2015). Therefore, it can be estimated that at least half of former English learners who attended elementary school in Washington should be correctly identified for the class of 2013/14, with lower percentages for previous classes and higher percentages for subsequent classes. Finally, students who were never classified as English learners between 2004/05 and 2017/18 are classified as never English learners.

Federal program enrollment

In addition to services for English language development, the federal government provides funding for free or reduced-price meals, services for migrant students, and services for students with special needs. I used longitudinal files to group students based on whether they were eligible for these programs in any year they attended Washington public schools. These time-invariant variables capture aspects of students' backgrounds that would be hidden in cross-sectional, year-by-year analysis.

School urbanicity

The study further defines students into groups based on the urbanicity of their school. School urbanicity was defined using National Center for Education Statistics (NCES) locale codes. Students in urban/suburban schools attended schools with NCES locale codes for city and suburban schools (codes 11–13 and 21–23), which are territories inside an urbanized area. Fringe schools are defined by NCES locale codes for towns less than 10 miles from an urbanized area (code 31) as well as rural territories that are less than 5 miles from an urbanized area and less than or equal to 2.5 miles from an urban cluster (code 41). Distant schools are identified by having an NCES locale codes for towns between 10 and 35 miles from an urbanized area (code 32) and rural territories that are between 5 and 25 miles from an urbanized area and between 2.5 and 10 miles from an urban cluster (code 42). Finally, remote schools are defined as schools with the NCES locale code for rural remote (code 43). They are rural territories more than 25 miles from an urbanized area and more than 10 miles from an urban cluster.

3.4.1.2 Defining Outcomes

The primary focus of the analyses in this dissertation is on measuring patterns in accelerated learning option course-taking and determining the effects of HB 1546 on CHS course enrollment and credit accrual. The study therefore carefully defines course-taking outcomes. Each of the approximately 65 million district-submitted course titles in student-level transcript files from OSPI was matched to a standardized course code based on an extensive set of decision rules vetted by content area experts in Washington state. Each course was assigned a type of accelerated learning option (i.e., AP, IB, CP, CHS, and Running Start) and a content area, according to 22 state-identified content areas. Washington modeled the content areas on the

NCES School Courses for the Exchange of Data (SCED) codes, which include English, mathematics, life and physical sciences, social studies, fine and performing arts, world language and literature, religion, physical education and health, military science, computer science, audio and visual communications, business and marketing, manufacturing, health sciences, public protective services, hospitality and tourism, architecture and construction, agriculture, human services, transportation, distribution and logistics, engineering and technology, and miscellaneous (U.S. Department of Education, National Center for Education Statistics, 2019b).

In addition to district-reported indicators for AP, IB, CP, CHS, and Running Start courses, which were inconsistently identified across school years, I located uncategorized accelerated learning option courses through key words in course titles and public lists of approved CHS courses. Furthermore, I standardized AP, IB, CP, CHS and Running Start course titles according to online information from the College Board, the International Baccalaureate and Cambridge Program International websites, online college course catalogues and public documents from OSPI listing approved courses for CHS subsidies. Finally, some analyses describe access to and participation in science, technology, engineering, and mathematics (STEM) courses. I defined STEM courses as courses in the content areas of math, life and physical sciences, computer science, health care science, and engineering.

3.4.1.3 Defining Predictor and Control Variables

Key predictors in this dissertation include membership in one of the student groups defined above, race/ethnicity, and indictors for whether and how students were impacted by HB 1546. I identified students impacted by HB 1546 in two ways. First, I identified students who attended schools that were eligible for subsidies based on their distance to a college that offered

Running Start, their student enrollment, or their percentage of students eligible for free or reduced-price lunch. Students who attended more than one school during a school year were assigned to the last school they attended. In Chapter 5, students were further grouped by their schools' priority for funding (Tier 1, Tier 2, Tier 3, or ineligible). In longitudinal analysis conducted in Chapter 6, students attending schools that met eligibility criteria were categorized as attending an eligible school based on meeting the criteria for Tier 1, Tier 2, or Tier 3, regardless of whether the policy had been implemented. Other analyses in Chapter 6 grouped students by whether or not they attended school in a year before or after the implementation of HB 1546.

Additional variables are defined in the study to show variation within samples and control for covariates that are unrelated to key predictors but may have influence on the outcomes. Some of these variables measure student characteristics and conditions prior to experiencing the intervention of HB 1546. First, a variable for chronic absenteeism in grade 9 was defined as attending school for fewer than 90 percent of days (less than 162 days). Another variable calculated whether students had ever experienced exclusionary discipline—been suspended or expelled—before grade 10. A variable for grade 9 grade point average was measured using district-reported cumulative grade point average in students' first ninth grade year. Grade 8 English language arts and math state assessment scores were standardized with a mean of 0 and a standard deviation of 1 within school year and test type.

3.4.1.4 Handling Missing Data

Certain factors, especially prior academic performance as measured by state assessment scores and grade point average, are highly associated with the outcome variables of enrolling accelerated learning option courses. However, 17 percent of students were missing one or more of these records. Typically, these students did not attend Washington state public schools in middle school and/or grade 9. To mitigate bias introduced by this missing data, I used a multiple imputation strategy to estimate missing values. The What Works Clearinghouse approves multiple imputation as a strategy for handling missing data (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2017b). I conducted five imputations using variables without missing data, including gender, ever eligible for special education services, English learner status (current, former, or never English learner student), ever eligible for migrant student services, the year the student was expected to graduate from high school, school urbanicity (remote, distant, fringe, or urban/suburban, based on the NCES locale codes), whether the student attended a school in the bottom 25 percent, middle 50 percent, or upper 25 percent in the state for the percentage of students eligible for free or reduced-price lunch, whether the student was suspended or expelled before grade 10, and the school district the student attended. Estimation with multiply imputed data was used to obtain adjusted standard errors. Records that were missing data for outcome variables were eliminated from analysis using listwise deletion. In addition, descriptive analyses do not use multiply imputed data. Cases where data are missing are excluded from descriptive analyses. Sample selection is described in each chapter and sample sizes are noted throughout the results.

4.0 Access, Participation and Equity in Washington State's Accelerated Learning Option Courses

The twin policy goals of increasing enrollment in accelerated learning option courses while making participation rates more equitable among traditionally underrepresented groups warrants analysis of the ways in which students from different backgrounds participate in accelerated learning option courses. Before measuring policy impacts, it is useful to establish an understanding of baseline trends in accelerated learning option course-taking among underrepresented groups to see when and where their access and enrollment outcomes vary. This section provides descriptive summaries of the accelerated learning option courses students took between 2009/10 and 2017/18, with an emphasis on comparing course-taking patterns for students from different racial/ethnic groups, students who were ever eligible for free or reduced-price lunch, students who were English learners, and students who attended school outside urban areas. It further measures the degree to which students' demographic backgrounds predict their participation in accelerated learning option courses before and after the implementation of HB 1546 and identifies underrepresented groups that improved their representation in accelerated learning option courses post-HB 1546.

4.1 Methods

I divide the analysis for chapter 4 into three sections. First, I describe access to and participation in accelerated learning option courses. Access is defined as attending a school that offers and enrolls students in accelerated learning option courses (i.e., enrolls students in AP, IB, CP, CHS, or Running Start courses). This analysis includes school- and student-level descriptive summaries. Second, I use statistical modeling to determine relationships among student characteristics and accelerated learning option course enrollment. Finally, I use a risk ratio analysis to examine under- and overrepresentation in advanced courses across student groups by race/ethnicity, eligibility for free or reduced-price lunch, English learner status, and school urbanicity.

I exclude Tech Prep course-taking from the analysis in part because these courses may not transfer to four-year colleges and in part due to data quality issues. Since federal Carl D. Perkins funding for Tech Prep dual credit options ceased in 2011, records of Tech Prep course enrollments were more difficult to discern from Running Start or CHS courses in the data. Course titles and other indicators that denote dual credit status may have identified some, but far from all of these courses as CHS or Running Start.

4.1.1 Sample

The full analytic sample includes 1,089,390 students enrolled in Washington state public high schools between 2009/10 and 2017/18. Table 4.1 presents sample sizes for each student group in the full sample. Sample exclusions apply for some of the analyses in this section. These are explained with each analysis and the sample sizes are presented alongside results.

Table 4.1. Analytic sample by student and school characteristics, 2009/10–2017/18.

Characteristic	Sample size	Percentage of sample
Student-level characteristics		
Number of students	1,089,390	N/A
Gender		
Female	531,382	48.8
Male	558,007	51.2
Race/ethnicity		
American Indian/Alaska Native	29,344	2.7
Asian	82,710	7.6
Black	54,905	5.0
Hispanic/Latino	196,549	18.0
Two or more races	57,464	5.3
White	666,709	61.2
Federal program enrollment		
Ever eligible for free or reduced-price lunch	569,754	52.3
Never eligible for free or reduced-price lunch	517,432	47.5
Current English learner	68,410	6.3
Former English learner	97,069	8.9
Never English learner	922,547	84.7
Ever eligible for migrant student services	25,060	2.3
Ever eligible for special education services	157,030	14.4
School-level characteristics		
Number of schools	849	N/A
Urbanicity[a]		
Urban/suburban	773,640	71.0
Fringe	137,523	12.6
Distant	108,074	9.9
Remote	68,789	6.3
Percent eligible for free or reduced-price lunch[a]		
Less than 25 percent	268,084	24.6
Between 25 and 49.9 percent	518,190	47.6
Between 50 and 74.9 percent	241,008	22.1
Between 75 and 100 percent	60,664	5.6

[a] To count students only one time, they are assigned to the modal category across the schools they attended between 2009/10 and 2017/18. In the absence of a mode, they are assigned to the least urban or highest-poverty category.
N/A: Not applicable
Note: Some sums of groups may not add up to the total number of students due to missing data or rounding.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2009/10–2017/18.

4.1.2 Patterns in Accelerated Learning Options Access and Participation

Analysis for this section begins with descriptive summaries of the accelerated learning option courses schools offer and the characteristics of schools that provide more or fewer accelerated learning option courses. It then features a discussion of how many and which students participate in accelerated learning option courses, and the courses most frequently taken in each advanced option type (AP, IB, CHS, CP, and Running Start). I disaggregated this analysis for each school year between 2009/10 and 2017/18, for students from different demographic backgrounds (e.g., by gender, race/ethnicity, English learner status, and eligibility for free or reduced-price lunch and the urbanicity of the school they attended.

I further report averages among student groups for the grade level when they took their first accelerated learning option course, the number of years they took accelerated learning option courses, and the number of accelerated learning option credits they earned during high school. Because results within school year were similar across time, many of the analyses in chapter 4 compare outcomes for the last baseline year before HB 1546 implementation (2014/15) and for the most recent year of data (2017/18). End-of-high school outcomes, such as the number of accelerated learning option courses taken overall, are measured for students in grade 12. Outcome data for students in earlier grades and students who left Washington public schools before grade 12 are not reported because they contain censored results. That is, these students may not have had a chance to experience an outcome before the last year of available data or that outcome is not otherwise observable.

4.1.3 Exploring Relationships Between Demographic Characteristics and Accelerated Learning Option Course Participation

After describing patterns in accelerated learning option course-taking, I used a regression framework to test whether there were statistically significant differences between groups in courses taken. First, I tested whether there were statistically significant differences in the likelihood of taking common accelerated learning option courses, such as college English, calculus, and biology, with a set of covariates to control for students' prior achievement, behavior, and attendance records. The logistic model used for this analysis is described in equation 4.1:

$$p(\text{acceleratedoption} = 1)_{ij} = \alpha + G_i + \boldsymbol{\delta}_{ij} + \mu_{ij} \qquad (4.1)$$

where p(acceleratedoption) represents the probability of enrolling in an accelerated learning option course in a particular content area for student i in school j, as a function of G, an indicator for whether student i belongs to a particular demographic category (gender, race/ethnicity, English learner status, free and reduced price lunch status, or urbanicity), $\boldsymbol{X}$, a vector of student-level prior achievement and behavioral characteristics including binary indicators set to 1 if student i was chronically absent in grade 9, whether student i had ever been suspended or expelled before grade 10, and whether student i attended a single school during grade 9 (a measure of mobility). $\boldsymbol{X}$ also includes continuous variables for grade 8 English language arts and math assessment scores, standardized to have a mean of 0 and a standard deviation of 1 within school year and test type, and grade 9 grade point average. $\boldsymbol{\delta}$ is a set of fixed effects for grade level. μ is a random effect for the school that student i attended.

Due to missing grade 8 and grade 9 covariates, an estimation strategy that made use of the multiply imputed datasets described in chapter 3 was employed to preserve sample sizes in the models and mitigate bias due to loss of data.

4.1.4 Identifying Disproportionate Representation in Accelerated Learning Option Courses

It is useful to have a point of reference when evaluating the magnitude of differences across groups. Lacking theoretically or scientifically established benchmarks from the literature to determine when a student group is under- or overrepresented in accelerated learning option courses, I leverage an empirical strategy, risk ratios, to analyze the representation of student groups in accelerated learning option courses (Bollmer, Bethel, Garrison-Morgen, & Bruen, 2007; Greenberg Motamedi, Cox, Williams & Deussen, 2016). I calculate risk ratios by dividing the percentage of the group of interest in accelerated learning option courses by the percentage of students from the referent group enrolled in accelerated learning option courses. For example, the percentage of Black students enrolled in an accelerated learning option course is divided by the percentage of White students enrolled in an accelerated learning option course. A risk ratio of 1 means that groups are equally likely to enroll in accelerated learning option courses. A risk ratio of more than one implies that Black students are more likely to enroll in accelerated learning option courses than White students. Conversely, a risk ratio of less than 1 implies that Black students are less likely to enroll in accelerated learning option courses than White students. Within groups of students under study, the referent categories are male students, White students, students who were never eligible for free or reduced-price lunch, students who were never English learners, and students who attended urban or suburban schools.

To identify which groups of students were under- or overrepresented in accelerated learning option courses, I set boundaries around a range considered "representative" using a district-level analysis. Within school year, I calculated the average risk ratio for Washington's school districts by dividing the percentage of a district's students enrolled in accelerated learning option courses by the percentage of all Washington students enrolled in accelerated learning option courses. I then placed district risk ratios into quartiles and fixed the range of risk ratios from the middle 50 percent of schools as being proportionately represented. Risk ratios outside these bounds, in the upper or lower quartiles, were set as disproportionate. In 2018, these calculations determined that risk ratios of less than 0.70 designate a group as underrepresented in accelerated learning option courses. Risk ratios higher than 1.23 indicate a group is overrepresented in accelerated learning option courses. In a follow-up analysis, I converted the risk ratios to percentages to ease the interpretation of the findings. A risk ratio of 1.00 is equal to the mean percentage among all students in Washington state (40 percent in 2017/18). Anything below 28.0 percent (a risk ratio of 0.70) is considered underrepresentation in accelerated learning option courses in comparison to the referent group. Anything above 49.2 percent (a risk ratio of 1.23) is considered overrepresentation in accelerated learning option courses relative to students in the referent group.

4.2 Results

This section discusses two sets of findings. First, it describes patterns in access to and participation in accelerated learning option courses. Then, it identifies student groups that are under- and overrepresented in accelerated learning option courses. Each analysis emphasizes comparisons among groups of students by demographic background, federal program enrollment status, and school urbanicity.

4.2.1 Access to and Participation in Accelerated Learning Option Courses

Apart from Running Start, students' choices for taking accelerated learning option courses are limited to those that their high school offers. The first few analyses in this section describe the accelerated learning programs schools offer and the characteristics of schools that offer different types of accelerated learning programs.

4.2.1.1 Prevalence of Accelerated Learning Programs

More than four in five regular high schools offer AP courses (table 4). On average, high schools that have an AP course offer 17 or 18 unique AP courses. The percentage of schools offering CHS courses grew from the baseline year before HB 1546 (2014/15) to the most recent year of data available, 2017/18, by 16 percentage points, making CHS programs almost as common as AP programs across Washington state's high schools. Nevertheless, a larger variety of AP and IB courses are available to students in schools with those programs than are CHS courses.

Table 4.2. Percentage of regular schools with students enrolled in accelerated learning option courses and average number of unique courses students enrolled in, 2014/15 and 2017/18

Accelerated learning option program	**Percentage of schools with students enrolled**		**Among schools with programs: number of unique courses offered with enrolled students**	
School year	**2014/15**	**2017/18**	**2014/15**	**2017/18**
Advanced Placement	84.7	83.2	17.2	18.4
Cambridge Program	3.8	4.2	8.6	9.8
College in the High School	66.4	82.5	11.2	13.6
International Baccalaureate	23.7	22.8	20.6	17.5
Running Start	67.2	58.0	7.3	4.3
Any accelerated learning option	96.5	96.7	14.7	17.4

Note: Sample includes 372 regular high schools in 2014/15 and 360 regular high schools in 2017/18. Regular high schools are designated by the Washington Office of Superintendent of Public Instruction. They exclude alternative schools, juvenile justice facilities, schools for students with special needs, and home services.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2014/15 and 2017/18

Many schools offered more than one type of accelerated learning program to students (table 4.3). In fact, over half of schools enrolled students in at least three types of accelerated learning option courses. Between 2014/15 and 2017/18, the percentage of schools offering no or one type of accelerated learning option course decreased by 3.7 percentage points. Although there were 12 fewer high schools in the 2017/18 sample than in the 2015/16 sample, among the 354 schools that were present in both years, the 3.7 percentage point decrease result holds (not shown).

Table 4.3. Variation across schools in the number of accelerated learning programs offered, 2014/15 and 2017/18

	Percentage of schools, by number of accelerated learning programs offered					
School year	**0**	**1**	**2**	**3**	**4**	**5**
2014/15	6.5	15.3	23.7	37.6	14.5	2.4
2017/18	5.3	12.8	28.1	36.7	15.8	1.4

Note: Sample includes 372 regular high schools in 2014/15 and 360 regular high schools in 2017/18. Regular high schools are designated by the Washington Office of Superintendent of Public Instruction. They exclude alternative schools, juvenile justice facilities, schools for students with special needs, and home services. Tech Prep programs are not included.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2014/15 and 2017/18

4.2.2.2 Characteristics of Schools that Offer Different Types of Accelerated Learning Programs

Schools that offered accelerated learning option courses tend to be large—they enroll over 1,000 students, on average (table 4.4). The less common CP and IB programs are offered in schools with over 1,500 students, on average. These two programs were offered almost exclusively in urban/suburban schools, which are also more racially/ethnically diverse. The other three programs—AP, CHS, and Running Start—are offered in schools with demographic compositions that represent the overall population of the state (see table 4.1).

Table 4.4. Average characteristics of schools that have students enrolled in accelerated learning option courses, by accelerated learning program, 2014/15 and 2017/18

School characteristic	School year	Advanced Placement	Cambridge Program	College in the High School	International Baccalaureate	Running Start
Number of schools	2014/15	315	14	247	88	250
	2017/18	294	15	297	82	209
Average student enrollment	2014/15	1,145.2	1,500.9	1,200.3	1,646.1	1,211.2
	2017/18	1,213.9	1,771.9	1,139.4	1,691.7	1,250.8
Racial/ethnic composition (%)						
American Indian/ Alaska Native	2014/15	3.5	2.1	2.8	2.2	3.6
	2017/18	3.3	2.1	2.7	2.5	2.5
Asian	2014/15	7.4	10.5	7.7	14.5	7.2
	2017/18	7.9	13.9	7.4	15.6	7.1
Black	2014/15	3.5	4.3	3.5	6.8	3.6
	2017/18	3.3	4.4	3.1	7.5	3.6
Hispanic/Latino	2014/15	17.6	22.5	18.4	17.9	19.6
	2017/18	17.7	17.2	18.4	19.1	18.9
Two or more	2014/15	5.3	5.5	5.3	6.2	5.5
	2017/18	5.9	6.1	5.6	7.2	6.1
White	2014/15	62.8	55.0	62.3	52.3	60.6
	2017/18	61.9	56.2	62.8	48.1	61.7
English learner composition (%)						
Current	2014/15	4.6	3.7	4.8	6.1	5.1
	2017/18	5.7	4.8	5.4	7.3	5.9
Former	2014/15	9.9	14.3	10.3	13.3	10.8
	2017/18	12.1	15.2	12.3	17.4	12.7
Never	2014/15	85.5	82.0	84.9	80.6	84.1
	2017/18	82.2	80.0	82.3	75.3	81.4
Free and reduced-price lunch composition (%)						
Ever eligible	2014/15	55.1	48.0	53.4	50.0	56.3
	2017/18	55.5	44.1	56.3	54.1	56.8
Currently eligible	2014/15	42.1	34.9	41.6	40.2	43.5
	2017/18	40.4	35.6	41.0	40.7	41.6
Other federal program enrollment (%)						
Ever migrant	2014/15	2.6	3.8	2.9	1.6	3.2
	2017/18	3.1	2.4	3.5	2.1	3.1
Ever special education	2014/15	13.3	9.6	12.4	10.7	13.3
	2017/18	15.4	11.3	15.7	13.0	15.4
Prior achievement (average)						
Grade 8 English language arts assessment scores	2014/15	0.137	0.293	0.175	0.240	0.120
	2017/18	0.210	0.410	0.190	0.288	0.182

Table 4.4. (continued).

School characteristic	School year	Advanced Placement	Cambridge Program	College in the High School	International Baccalaureate	Running Start
Grade 8 math assessment scores	2014/15	0.158	0.272	0.208	0.307	0.150
	2017/18	0.234	0.478	0.214	0.350	0.211
Grade 9 grade point average	2014/15	2.87	2.59	2.92	2.82	2.84
	2017/18	3.00	3.11	2.98	2.93	2.96
School urbanicity (%)						
Urban/suburban	2014/15	54.0	71.4	56.3	89.8	57.2
	2017/18	49.7	93.3	46.4	82.9	52.6
Fringe	2014/15	14.6	7.1	15.0	6.8	16.4
	2017/18	15.3	6.7	14.5	7.3	16.3
Distant	2014/15	17.1	21.4	16.6	3.4	14.0
	2017/18	20.7	0.0	20.5	9.8	17.7
Remote	2014/15	14.3	0.0	12.1	0.0	12.4
	2017/18	14.3	0.0	18.5	0.0	13.4

Note: Sample includes 372 regular high schools in 2014/15 and 360 regular high schools in 2017/18. Regular high schools are designated by the Washington Office of Superintendent of Public Instruction. They exclude alternative schools, juvenile justice facilities, schools for students with special needs, and home services. Grade 8 assessment scores are standardized within school year and test type to have a mean of 0 and a standard deviation of 1.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2014/15 and 2017/18

These findings suggest that accelerated learning option courses are offered in nearly every regular high school. By extension, the students served by schools that offer accelerated learning option courses represent similar levels of diversity as the overall state population. While access to accelerated learning options at the school level may seem equitable, student-level analysis can reveal differences in the percentages of students enrolling in accelerated learning option courses and the types of courses they enroll in. The following section analyzes student-level data on participation in accelerated learning option courses. First, it lists the most frequently taken accelerated learning option courses throughout a nine-year timespan. Then, participation in common accelerated learning option courses is compared among student groups. Results, which are similar over time, are shown for the year prior to HB 1546 implementation—

2014/15, and the most recent year available, 2017/18. This is followed by a presentation of findings that show the extent to which belonging to a particular demographic group predicts enrollment in certain accelerated learning option courses. Finally, differences in when students first take accelerated learning option courses and how many years in which they participate in accelerated learning option courses are compared among demographic groups.

4.2.2.3 Frequently Taken Accelerated Learning Option Courses

For the most part, students take courses that can apply to general education or major requirements in college (table 4.5). The most commonly taken courses include English (language, composition, literature), social studies (history, government/politics, geography), Spanish, science (biology, chemistry) and math (precalculus, calculus, general advanced math). Within accelerated learning option course type, the top two to three most frequently taken courses tend to be consistent across time.

Unlike the courses above that can help reduce the cost and time it takes to earn a college degree, physical education courses were among the top five most frequently taken Running Start courses in every year from 2009/10 to 2017/18. These courses do not typically count towards a degree. They also usually only count for 0.2 high school credits—one tenth of the two physical education and health credits the state requires to earn a high school diploma. Students who leveraged Running Start as a way to meet this high school requirement would need to take several Running Start classes to do so, which may explain the high frequency of enrollment in physical education courses.

Table 4.5. Most frequently taken accelerated learning option courses, ranked by course type and school year, 2009/10–2017/18

	Rank in frequency of students taking course by school year								
Course (N across all years)	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**2016/17**	**2017/18**
Advanced Placement									
English Language and Composition (119,939)	1	1	1	1	1	1	1	2	2
US History (94,062)	2	2	2	2	2	3	3	3	3
English Literature and Composition (73,448)	5	5	5	5	4				
World History: Modern (72,211)	4	3	3	3	3	2	2	1	1
Calculus AB (70,494)	3	4	4	4	5	4	5	5	5
Human Geography (36,086)						5	4	4	4
Cambridge Program[a]									
English Language (2,117)	2	1	1	1	1	1	1	1	1
History (1,877)			3	2	2	2	2	2	2
English Literature (1,365)	1	2	4	4	3	3			
Biology (1,122)			2	3	4	4	3	3	4
Math (751)	4	3				5	4	4	3
Further Math (668)			5	5	5		5		
Accounting (105)	3	4							
Government/Politics (550)								5	5
College in the High School									
Spanish (41,379)	2	2	1	1	1	1	1	2	2
Precalculus I (41,158)	3	4	3	3	3	2	2	1	1
English 101 (38,079)	4	3	4	4	4	4	3	3	3
Principles of Chemistry (37,719)	1	1	2	2	2	3	4	4	4
Calculus I (17,035)							5	5	
American History (15,628)			5	5					5
French (11,956)					5				
World history (10,174)						5			
Environmental science (7,577)		5							
Computer Science (5,921)	5								
International Baccalaureate									
English Language and Literature (22,085)	1	1	1	1	1	1	1	1	1
Math studies (17,230)	3	4	3	3	3	2	2	2	2
History of the Americas (16,486)	2	2	2	2	2	3	3	3	3
Spanish (11,456)	4	3	4	4	4	4	4	4	4
Biology (9,304)	5		5	5			5	5	
Theory of Knowledge (8,724)									5
Humanities (3,989)					5	5			
Further Math (3,536)		5							

Table 4.5 (continued).

Course (N across all years)	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
	Rank in frequency of students taking course by school year								
Running Start									
Spanish (33,120)	1	1	1	1	1	1	1	1	1
American History (26,621)	2	2	2	2	2	2	3	3	3
English 101: Reading and Responding (21,587)	3	3	4	3	3				5
Physical Education (19,425)	4	5	3	4	5	4	4	4	4
Biology (16,600)	5	4	5	5		3	2	2	2
Political Science/ Government (15,665)						5	5		
English elective (11,524)					4				
World History (11,480)								5	

[a] Only four Cambridge Program courses were taken in 2009/10 and 2010/11.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2009/10–2017/18

Although popular courses were consistent within accelerated learning programs over time, the types of accelerated learning option courses students participated in varied by demographic group (tables 4.6 and 4.7). Table 4.6 presents the percentages of students from several demographic groups who enrolled in any accelerated learning option course and in common non-STEM content areas. Overall, participation in most of these accelerated learning option courses rose between 2014/15 and 2017/18, within courses and across demographic groups, with only a few minor exceptions. The highest percentages of student participation are found among English and history accelerated learning option courses. Participation rates are in double digits across most demographic groups in these content areas.

A few noteworthy differences in participation rates surfaced in the results. First, female students participate at higher rates than male students overall and among most non-STEM courses. The exceptions are physical education and political science and economics courses, where male students have higher participation rates. When examining variation across racial/ethnic groups, Asian students have clearly higher participation rates than students in other groups. More than half of Asian students participated in an accelerated learning option course in each year. Fifty-seven percent of Asian students took at least one accelerated learning option course in 2017/18. This is more than twice the percentage of American Indian/Alaska Native students who took an accelerated learning option course in that year (25 percent).

There are substantial gaps in participation rates between students who were ever eligible for free or reduced-price lunch and those that were never eligible. Participation rates in any accelerated learning option course are about 20 percentage points lower for students who have experienced poverty. Among most course options, students who have never been eligible for free or reduced-price lunch participate in certain accelerated learning option courses at rates that are more than double those of students who were ever eligible within different courses.

Although participation rates for current English learners lag behind those of their peers whose first language was English or who achieved English proficiency before high school, almost a quarter of students who were eligible for English language development services in high school participated in an accelerated learning options course in 2017/18. Former English learners have similar participation rates in accelerated learning option courses overall and among non-STEM courses as students who were never English learners. This suggests that any difficulties acquiring foundational content area skills while learning English did not, in general, hold English learners who reclassified as English proficient before high school back from participating in accelerated learning options courses relative to peers who were never English learners.

Students from fringe and distant schools greatly increased their participation in accelerated learning option courses between 2014/15 and 2017/18 (13.1 and 11.5 percentage point increases, respectively). While there were modest increases in their participation across non-STEM subject areas, this substantial increase is driven largely by increases in STEM accelerated learning option course enrollment (see table 4.7). The increase among students in fringe schools closed the gap in participation rates relative to students in urban and suburban schools that was present in 2014/15. This pattern corresponds with the focus of HB 1546's CHS subsidies, which prioritize schools that are located far from colleges that offer Running Start courses.

Table 4.6. Percentage of students enrolled in an accelerated learning option course by demographic group, 2014/15 and 2017/18

	Any course		**Art**		**English**		**History**		**Physical education**		**Political science/ economics**		**World languages**	
School year / Student group	**2014/ 15**	**2017/ 18**	**2014/ 15**	**2017/ 18**	**2014/ 15**	**2017/ 18**	**2014/ 15**	**2017/ 18**	**2014/ 15**	**2017/ 18**	**2014/ 15**	**2017/ 18**	**2014/ 15**	**2017/ 18**
All students	35.2	40.0	1.8	2.2	12.3	13.1	14.0	15.2	1.0	1.4	3.4	4.2	8.8	10.5
Gender														
Female	37.7	42.6	2.2	2.7	14.5	15.2	15.4	16.7	0.9	1.4	4.0	4.2	9.9	11.7
Male	32.7	37.6	1.3	1.7	10.2	11.1	12.8	13.7	1.1	1.4	3.8	4.2	7.9	9.4
Race/ethnicity														
American Indian/ Alaska Native	23.7	25.0	1.4	1.7	8.7	8.7	8.0	8.0	1.0	1.1	2.3	2.4	3.7	4.6
Asian	52.7	57.4	2.8	2.9	21.9	21.2	26.4	28.2	0.6	1.1	6.5	7.4	15.3	17.8
Black	29.7	35.7	1.2	1.7	12.3	14.0	11.9	13.3	0.7	1.4	2.5	3.5	4.6	6.4
Hispanic/Latino	26.8	33.2	1.0	1.3	8.8	10.1	9.4	10.9	0.8	1.1	2.1	2.7	7.5	9.9
Two or more	35.4	41.8	1.9	2.7	13.1	13.7	15.1	16.6	1.4	1.7	4.2	4.4	9.4	11.7
White	36.0	40.1	1.9	2.4	12.2	12.9	14.3	14.9	1.1	1.6	4.3	4.4	8.9	10.1
Free or reduced-price lunch														
Ever eligible	26.2	31.6	1.3	1.8	8.3	9.2	9.6	10.4	0.9	1.3	2.2	2.7	5.5	7.1
Never eligible	46.3	51.0	2.3	2.7	17.5	18.4	19.8	21.6	1.0	1.6	6.2	6.3	13.2	15.1
English language status														
Current	18.4	22.5	0.8	1.0	4.5	5.2	4.8	5.0	0.9	1.0	1.1	1.9	3.9	5.3
Former	33.4	43.7	1.1	1.6	11.3	13.3	13.3	16.9	0.6	1.1	2.6	3.5	8.7	13.1
Never	36.3	40.7	1.9	2.4	13.0	13.8	14.8	15.8	1.0	1.5	4.3	4.5	9.2	10.5
School urbanicity														
Urban/suburban	38.4	42.1	1.9	2.4	13.7	14.6	15.8	16.7	1.2	0.7	4.4	4.3	9.9	11.9
Fringe	29.6	42.7	1.7	2.6	9.5	11.0	10.2	12.9	0.5	5.0	2.7	5.6	7.9	10.3
Distant	19.3	30.8	1.0	1.3	7.1	8.7	7.0	11.5	0.3	1.5	1.8	2.6	2.6	5.7
Remote	21.5	22.8	0.5	0.5	6.3	8.3	8.3	9.1	0.2	0.6	2.3	2.8	5.4	3.5

Note: The sample includes 338,389 students in 2014/15 and 345,934 students in 2017/18.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2014/15 and 2017/18

Table 4.7. Percentage of students enrolled in a STEM accelerated learning option course by demographic group, 2014/15 and 2017/18

	Any STEM course		**Biology**		**Calculus/ precalculus**		**Chemistry**		**Computer science**		**Engineering**		**Physics**	
School year / Student group	**2014/ 15**	**2017/ 18**	**2014/ 15**	**2017/ 18**	**2014/ 15**	**2017/ 18**	**2014/ 15**	**2017/ 18**	**2014/ 15**	**2017/ 18**	**2014/ 15**	**2017/ 18**	**2014/ 15**	**2017/ 18**
All students	17.2	21.3	4.9	5.3	6.0	8.1	4.5	5.4	1.4	3.1	0.3	0.6	2.8	3.0
Gender														
Female	17.5	21.4	5.6	6.1	5.9	8.1	4.7	5.7	0.7	2.0	0.1	0.2	2.1	2.2
Male	17.0	21.1	4.3	4.5	6.0	8.1	4.4	5.1	2.1	4.2	0.4	0.8	3.4	3.7
Race/ethnicity														
American Indian/ Alaska Native	9.3	10.4	2.2	2.4	2.4	2.9	1.9	2.1	0.5	1.1	0.1	0.2	0.9	0.9
Asian	33.6	37.7	11.0	11.1	14.1	18.7	11.1	11.5	5.3	7.8	0.7	0.7	8.6	9.3
Black	11.7	15.1	3.2	3.3	2.4	3.9	2.0	3.0	0.9	1.7	0.2	0.3	1.4	1.2
Hispanic/Latino	10.6	14.9	2.6	3.3	3.0	4.4	2.1	3.1	0.4	2.4	0.1	0.3	1.4	1.2
Two or more	17.3	21.2	4.9	5.5	5.7	8.2	4.7	5.5	1.5	2.8	0.3	0.6	2.8	2.9
White	18.0	21.9	5.1	5.4	6.4	8.4	4.8	5.6	1.3	3.0	0.2	0.6	2.7	2.9
Free or reduced-price lunch														
Ever eligible	10.8	14.5	3.0	3.4	2.8	4.3	2.3	3.0	0.6	2.2	0.1	0.4	1.4	1.3
Never eligible	25.5	30.5	7.4	8.0	10.2	13.4	7.4	8.7	2.4	4.4	0.4	0.7	4.5	5.3
English language status														
Current	7.4	9.6	1.6	1.9	1.8	2.3	1.2	1.7	0.6	2.1	0.2	0.2	1.6	1.0
Former	15.8	22.6	4.3	5.7	4.7	8.3	3.9	5.7	1.3	3.6	0.3	0.5	2.5	3.1
Never	18.0	22.1	5.2	5.6	6.5	8.6	4.9	5.7	1.5	3.1	0.3	0.6	2.9	3.2
School urbanicity														
Urban/suburban	19.8	22.2	5.8	5.5	6.6	8.7	1.7	5.7	0.3	3.4	0.3	0.5	3.7	3.7
Fringe	11.4	24.7	2.6	6.6	5.8	8.9	2.0	6.3	1.1	3.3	0.1	0.8	1.3	2.2
Distant	7.1	16.8	1.6	4.3	3.1	5.6	0.8	4.0	0.1	2.1	0.0	0.4	0.8	0.8
Remote	7.2	9.2	2.5	2.1	2.3	3.9	1.1	1.9	0.1	0.8	0.0	0.1	0.6	1.0

Note: STEM is science, technology, engineering, and mathematics. The sample includes 338,389 students in 2014/15 and 345,934 students in 2017/18.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2014/15 and 2017/18

Above, table 4.7 shows the percentage of students who participated in STEM accelerated learning option courses, alongside some examples of frequently taken STEM courses. STEM accelerated learning option course participation rates increased slightly between 2014/15 and 2017/18 across all courses—between 0.2 percent for physics and 2.1 percent for calculus and precalculus courses. Calculus and precalculus courses had the highest participation rates among STEM courses, at 8.1 percent in 2017/18. This was followed by chemistry and biology at 5.4 and 5.3 percent, respectively.

As with non-STEM accelerated learning option courses, participation rates varied across demographic groups. The participation rates of Asian students (33.6 percent) stand out, as they are about 16 percentage points higher than the group with the next highest participation rate (White students, 18 percent), and are often many times higher than participation rates of other racial/ethnic groups within specific STEM courses. For example, their participation rates in calculus and precalculus courses are more than 6 times higher than the participation rates of American Indian and Alaska Native students in 2017/18.

Consistent with previous results, students who have experienced poverty participate in STEM accelerated learning option courses at rates that are less than half of those of students who have never experienced poverty. This gap is largest for calculus and precalculus courses, in which 13.4 percent of students who were never eligible for free or reduced-price lunch participated while only 4.3 percent of students who had been eligible for free or reduced-price lunch did so in 2017/18.

Differences in STEM accelerated learning option course participation rates were not present among some groups. Former English learners closed a gap in STEM accelerated learning option course participation. In 2014/15, former English learners participated in STEM accelerated learning option courses at a rate that was 2.2 percentage points lower than never English learners. In 2017/18, their participation rate was 0.5 percentage points higher than that of never English learners. Across individual STEM courses, former and never English learners participate at comparable rates. Similarly, female and male students participated in STEM courses overall at similar rates. In some STEM courses, such as biology and chemistry, female students have slightly higher participation rates. In others, male students enroll at higher rates (e.g., engineering and physics). In calculus and precalculus courses, their participation rates are the same—8.1 percent.

Students attending schools on the fringe of urban areas more than doubled their participation rates in STEM accelerated learning option courses between 2014/15 and 2017/18—from 11.4 to 24.7 percent. In 2017/18, they had higher participation rates than urban/suburban students. Students in distant schools also more than doubled their participation rates in STEM accelerated learning option courses. Contributing to this overall gain are increases in biology, calculus and precalculus, chemistry, and computer science accelerated learning option course participation.

In sum, participation in accelerated learning option courses is growing across courses in most content areas. As participation rates increase, some gaps between student groups have declined or disappeared, such as for students attending fringe or distant schools and for former English learners. Other participation gaps, however, are large and persistent across time, such as those for students who have experienced poverty and American Indian/Alaska Native students.

4.2.2 Demographic Characteristics as Predictors of Enrollment in Accelerated Learning Option Courses

The prior section showed some promising results for closing gaps in accelerated learning option course-taking, such as that female and male students participate in calculus and pre-calculus courses at the same rate. Those results, however, do not account for variation in academic preparation among groups. The following findings show that after controlling for prior achievement, behavioral, and attendance records, gender, poverty, and English learner status were strongly related to accelerated learning option course enrollment. Table 4.8 reports odds ratios for participating in certain popular accelerated learning option courses compared to the stated reference group in 2017/18. Values greater than 1 indicate that the group has higher odds of participating in the course than the odds of the referent group. Likewise, values below 1 mean that the group has lower odds of participating in the course than the odds of the referent group.

The results show that given similar prior achievement, behavior, and attendance profiles, male students have higher odds of participating in STEM accelerated learning option courses than the odds for female students. On the other hand, they have lower odds of participating in art, English, and world languages courses than those of female students. The results support some of the descriptive findings in tables 8 and 9. For example, female students have a 1.6 percentage point higher participation rate in biology accelerated learning option courses than male students, which reflects the result that male students' odds of enrolling in biology accelerated learning option courses are lower than those of female students after controlling for prior achievement, behavior, and attendance (a statistically significant odds ratio of 0.865).

On the other hand, the results uncover some patterns that are not evident in the descriptive analysis. Table 4.7 shows equal participation in calculus and precalculus accelerated learning option courses in 2017/18 among female and male students (8.1 percent). However, this result does not account for variation between groups in academic preparedness. When female and male students are equally prepared, the results from the predictive model suggest that the odds favor male students to enroll in precalculus and calculus courses (a statistically significant odds ratio of 1.33).

The more concerning results are for students who have experienced poverty, as measured by ever being eligible for free or reduced-price lunch. These students, even when they have similar academic preparation, have consistently and often dramatically lower odds of enrolling in all accelerated learning option courses than the odds of students who have never been eligible for free or reduced-price lunch. The only results that are not statistically significant are those for art and physical education courses. This implies that when courses are not likely to count towards a postsecondary degree, low-income students have a more or less an equal chance of enrolling in accelerated learning option courses as students from higher-income families. Among courses that have the potential to cut the cost and time it takes to complete a degree by fulfilling core requirements of a major area of study, the students who could most benefit from a financial break are often excluded.

Results were more promising for English learners relative to students who have never been English learners. Current English learners had lower odds of enrolling in accelerated learning option courses than those of never English learners only in art and engineering courses. They had higher odds of enrolling in computer science courses. This lack of difference in outcomes suggests that differences in academic preparation in core content areas can explain much of the differences in percentages of students enrolled in accelerated learning option courses shown in tables 8 and 9. Furthermore, former English learners had consistently higher odds of enrolling in accelerated learning option courses than the odds of never English learners after accounting for prior achievement, behavior, and attendance. Not surprisingly, their largest difference over never English learners was in world languages accelerated learning option courses (1.494), but this was followed closely by similarly high odds in taking a precalculus and calculus accelerated learning option course relative to the odds of never English learners doing so (1.408).

Table 4.8. Relationships between gender, eligibility for free or reduced-price lunch, or English learner status and the probability of enrolling in accelerated learning option courses, 2017/18

Group / Course	Male, relative to female	Ever eligible for free or reduced-price lunch, relative to never eligible	English learner status, relative to never English learner	
			Current	Former
Any accelerated learning option course	0.966 (0.012)	0.754*** (0.037)	1.005 (0.086)	1.307*** (0.086)
Art	0.652*** (0.035)	0.858 (0.088)	0.627** (0.104)	0.752 (0.112)
English	0.796*** (0.027)	0.748*** (0.054)	0.843 (0.110)	1.224* (0.103)
History	0.989 (0.023)	0.833** (0.052)	0.799 (0.131)	1.375*** (0.105)
Physical education	1.021 (0.164)	0.887 (0.200)	0.640 (0.187)	0.745 (0.257)
Political science/ Economics	1.203*** (0.044)	0.633*** (0.063)	0.852 (0.155)	0.981 (0.094)
World languages	0.900** (0.033)	0.683*** (0.484)	1.051 (0.138)	1.494*** (0.143)
Any accelerated learning options STEM course	1.208*** (0.032)	0.689*** (0.041)	1.005 (0.086)	1.307*** (0.082)
Biology	0.865** (0.045)	0.741** (0.761)	0.851 (0.158)	1.232 (0.143)
Calculus/ precalculus	1.330*** (0.052)	0.656*** (0.055)	0.985 (0.120)	1.408*** (0.121)
Chemistry	1.094* (0.039)	0.652*** (0.067)	0.876 (0.128)	1.271* (0.141)
Computer science	2.374*** (0.319)	0.759* (0.095)	1.351** (0.150)	1.328** (0.132)
Engineering	3.833*** (0.624)	0.755* (0.093)	0.528* (0.141)	0.885 (0.201)
Physics	2.255*** (0.117)	0.544*** (0.049)	1.251 (0.248)	1.342*** (0.100)

Note: STEM is science, technology, engineering, and mathematics. Sample includes 343,738 observations in 2017/18. Each group and course combination represents a separate student-level specification, with controls for grade 8 English language arts and math assessment scores, standardized to have a mean of 0 and a standard deviation of 1 within school year and test type, grade 9 grade point average, and grade level.
Source: Author’s analysis of Washington Office of Superintendent of Public Instruction data, 2017/18

Many of the differences across racial/ethnic groups in the odds of enrolling in accelerated learning option courses shown in tables 4.6 and 4.7 could be explained by differences in prior achievement, behavior, and attendance (table 4.9). Given equal preparation, Black students show higher odds of enrolling in accelerated learning option courses than White students (an odds ratio of 1.482), higher odds of enrolling in English and history accelerated learning option courses, and no other meaningful differences across other courses and content areas. Results are similar for Hispanic/Latino students, who also have higher odds of enrolling in world languages accelerated learning option courses than those of White students (an odds ratio of 1.480).

Apart from art and physical education courses—courses that less often count towards postsecondary degree requirements—Asian students have categorically higher odds of enrolling in accelerated learning option courses across the spectrum of content areas than those of White students. Their odds of enrolling in computer science and physics courses are more than double the odds of White students with similar prior achievement enrolling in those courses.

Finally, American Indian and Alaska Native students had consistently lower odds of participating in STEM accelerated learning option courses compared to those of similarly prepared White students. Apart from higher odds of participating in English accelerated learning option courses, there were no statistically significant differences in the odds of enrolling in non-STEM accelerated learning option courses relative to White peers. The results cannot determine whether this is a factor of the variety and number of accelerated learning option courses available in schools that serve higher shares of American Indian/Alaska Native students or other, more challenging to observe factors, such as personal interests in and confidence with STEM content, or the quality and availability of STEM teachers in Native students' K–12 educational experiences.

Table 4.9. Relationship between race/ethnicity and the probability of enrolling in accelerated learning option courses

	Race/ethnicity, relative to White students				
Group / Course	**American Indian/ Alaska Native**	**Asian**	**Black**	**Hispanic/ Latino**	**Two or more**
Any accelerated learning option course	0.892 (0.059)	1.754*** (0.132)	1.482*** (0.128)	1.210** (0.072)	1.249*** (0.048)
Art	0.961 (0.121)	1.088 (0.188)	0.875 (0.145)	0.650* (0.088)	1.213* (0.097)
English	1.277** (0.106)	1.686*** (0.162)	2.189*** (0.282)	1.302** (0.129)	1.248*** (0.052)
History	1.025 (0.089)	1.888*** (0.184)	1.762*** (0.206)	1.248* (0.137)	1.317*** (0.053)
Physical education	0.756 (0.177)	0.647 (0.191)	0.929 (0.323)	0.681 (0.198)	1.104 (0.118)
Political science/ Economics	0.970 (0.147)	1.561*** (0.176)	1.257 (0.219)	0.925 (0.097)	1.148* (0.062)
World languages	0.717** (0.085)	1.572*** (0.196)	0.949 (0.099)	1.480*** (0.131)	1.291*** (0.092)
Any accelerated learning options STEM course	0.782*** (0.0581)	1.848*** (0.153)	1.150 (0.113)	1.047 (0.069)	1.071 (0.047)
Biology	0.822 (0.095)	1.690*** (0.225)	1.034 (0.190)	0.971 (0.103)	1.118 (0.071)
Calculus/ precalculus	0.819* (0.079)	1.989*** (0.264)	1.053 (0.122)	1.088 (0.118)	1.122* (0.064)
Chemistry	0.764* (0.100)	1.633*** (0.193)	1.022 (0.159)	0.991 (0.113)	1.082 (0.077)
Computer science	0.553*** (0.077)	2.216*** (0.312)	0.853 (0.123)	1.145 (0.192)	0.996 (0.094)
Engineering	0.505* (0.156)	0.878 (0.254)	0.778 (0.236)	0.648 (0.152)	0.981 (0.218)
Physics	0.760 (0.145)	2.564*** (0.319)	0.900 (0.106)	0.832 (0.088)	1.093 (0.072)

Note: STEM is science, technology, engineering, and mathematics. Sample includes 343,738 observations in 2017/18. Each row represents a separate student-level specification, with controls for grade 8 English language arts and math assessment scores, standardized to have a mean of 0 and a standard deviation of 1 within school year and test type, grade 9 grade point average, and grade level.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2017/18

There were few differences in the odds of enrolling in accelerated learning option courses among similarly prepared students from fringe and distant schools relative to students attending urban and suburban schools (table 4.10). Students attending schools on the fringe of urbanized areas had higher odds of participating in physical education accelerated learning option courses and lower odds of participating in English, history, and physics courses than those of similarly prepared students attending school in urban and suburban areas. Students attending distant schools tended to have lower odds of participating in accelerated learning option courses than those of similarly prepared students in urban and suburban schools. However, only a few were statistically significant—the odds of enrolling in any accelerated learning option course, and the odds of enrolling in English or physics accelerated learning option courses. In each of those cases, their odds were about half or less than half of the odds of students attending urban and suburban schools.

Across the board, students in remote schools had lower odds of participating in accelerated learning option courses than similarly prepared students in urban and suburban schools. Specifically, their odds of participating in any accelerated learning option course are less than half of those for students in urban and suburban schools (an odds ratio of 0.404), and they are even lower among STEM accelerated learning option courses (an odds ratio of 0.386). These findings correspond to lower levels of access to accelerated learning options in remote schools. For example, as shown in table 4.4, no CP or IB courses were offered to students in remote schools in 2017/18.

Table 4.10. Relationship between school urbanicity and the probability of enrolling in accelerated learning option courses

Group / Course	Urbanicity, relative to urban/suburban schools		
	Fringe	**Distant**	**Remote**
Any accelerated learning option course	0.989 (0.187)	0.599** (0.109)	0.404*** (0.082)
Art	1.062 (0.462)	0.559 (0.228)	0.204*** (0.071)
English	0.644** (0.104)	0.555*** (0.089)	0.573* (0.150)
History	0.671* (0.119)	0.690 (0.216)	0.586* (0.153)
Physical education	6.939** (4.372)	1.976 (1.519)	0.787 (0.668)
Political science/ Economics	1.364 (0.427)	0.644 (0.158)	0.778 (0.240)
World languages	0.830 (0.275)	0.477 (0.219)	0.302* (0.155)
Any accelerated learning options STEM course	1.168 (0.291)	0.768 (0.203)	0.386*** (0.080)
Biology	1.204 (0.563)	0.873 (0.514)	0.451* (0.150)
Calculus/ precalculus	1.031 (0.188)	0.731 (0.163)	0.576* (0.127)
Chemistry	1.119 (0.405)	0.789 (0.400)	0.408 (0.209)
Computer science	0.950 (0.573)	0.683 (0.291)	0.283*** (0.108)
Engineering	1.518 (1.253)	0.754 (0.519)	0.202* (0.147)
Physics	0.551** (0.112)	0.238*** (0.065)	0.364* (0.181)

Note: STEM is science, technology, engineering, and mathematics. Sample includes 343,738 observations in 2017/18. Each row represents a separate student-level specification, with controls for grade 8 English language arts and math assessment scores, standardized to have a mean of 0 and a standard deviation of 1 within school year and test type, grade 9 grade point average, and grade level.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2017/18

Some of the participation gaps may be explained by differences in when and how often students take accelerated learning option courses, and how many courses they take. Table 4.11 reports the average grade level when students took their first accelerated learning option course, the average number of years they participated in accelerated learning option courses, and the average number of accelerated learning options credits they earned by the end of high school. The sample is limited to students in grade 12 because data for students in earlier grades and students who left Washington public schools before grade 12 are censored (i.e., they have not yet had a chance to experience an outcome or that outcome is not otherwise observable).

Students typically took their first accelerated learning option course between grades 10 and 11. Averages ranged from 10.3 for Asian students to 11.0 for current English learners. The higher average among current English learners can be due to structural factors as well as academic preparedness for advanced coursework. For example, some schools may have policies that require reclassification as English proficient to participate in accelerated learning option courses (Estrada, 2014; Kanno & Kangas, 2014) and some may substitute English language development courses for core content courses in such a way that English learners do not fulfill prerequisites (Umansky, 2015). However, students in distant schools also waited until grade 11 to enroll in an accelerated learning option course, on average. This cannot be explained by a disproportionate percentage of current English learners in distant schools (8.4 percent, versus 8.5 percent in urban/suburban schools), but may also relate to the types of accelerated learning option courses offered in distant schools and patterns in local policies for enrolling in them.

Additionally, when students start taking accelerated learning option courses earlier, they have more time to earn credits in them. As the average grade level in which students took their first accelerated options course decreased between 2014/15 and 2017/18, the average number of years students took accelerated learning option courses and the average number of accelerated learning options credits earned during high school increased. The rates of change vary by student group. For example, the average grade level for enrolling in an accelerated learning option course among White decreased from 10.6 in 2014/15 to 10.5 in 2017/18. This 0.1 grade-level drop corresponded with a 1.1-credit increase in the number of credits earned in accelerated learning option courses by the end of high school. At the same time, students who were eligible for free or reduced-price lunch at any time decreased their average grade level of first enrollment in an accelerated learning option course from 10.7 to 10.6. This 0.1 grade-level decrease corresponded with a 0.3-credit increase in the number of accelerated learning options credits earned during high school. This result implies that as students in some groups start taking accelerated learning option courses earlier, they also take more of them by the end of high school. Students in other groups may be starting a little earlier, but gradual changes have yet to translate to meaningful increases in credits earned.

Table 4.11. Grade level in which first accelerated learning option course was taken, average number of years enrolled in accelerated learning option courses, and average number of accelerated learning option credits earned among students in grade 12, 2014/15 and 2017/18

Student group	Average grade level when first accelerated learning option course was taken		Average number of years enrolled in accelerated learning option courses		Average number of credits earned in accelerated learning option courses during high school	
School year	**2014/15**	**2017/18**	**2014/15**	**2017/18**	**2014/15**	**2017/18**
All	10.6 (0.9)	10.5 (0.9)	2.2 (0.9)	2.4 (1.0)	6.8 (0.8)	7.4 (8.4)
Gender						
Female	10.6 (0.9)	10.5 (0.9)	2.2 (0.9)	2.5 (0.9)	7.0 (8.2)	7.8 (8.5)
Male	10.7 (0.9)	10.5 (1.0)	2.2 (0.9)	2.4 (1.0)	6.6 (7.9)	7.0 (8.3)
Race/ethnicity						
American Indian/ Alaska Native	10.8 (0.9)	10.6 (1.0)	2.0 (0.9)	2.2 (1.0)	5.1 (6.6)	5.6 (6.8)
Asian	10.5 (0.9)	10.3 (0.9)	2.4 (0.9)	2.7 (0.9)	11.2 (11.4)	11.7 (11.5)
Black	10.8 (0.9)	10.7 (0.9)	2.1 (0.9)	2.2 (0.9)	6.3 (7.4)	6.4 (7.1)
Hispanic/Latino	10.8 (0.9)	10.7 (0.9)	2.1 (0.9)	2.2 (0.9)	5.0 (6.3)	5.5 (6.7)
Two or more	10.6 (0.9)	10.4 (0.9)	2.2 (0.9)	2.5 (1.0)	6.8 (8.2)	7.6 (8.9)
White	10.6 (0.9)	10.5 (0.9)	2.2 (0.9)	2.5 (1.0)	6.3 (7.5)	7.4 (8.1)
Eligibility for free or reduced-price lunch						
Ever eligible	10.7 (0.9)	10.6 (1.0)	2.1 (0.9)	2.3 (1.0)	5.3 (6.7)	5.6 (6.8)
Never Eligible	10.6 (0.9)	10.4 (0.9)	2.3 (0.9)	2.6 (0.9)	8.0 (8.7)	9.3 (9.5)
English learner status						
Current	11.0 (0.9)	11.0 (1.0)	2.0 (0.9)	1.9 (0.9)	3.8 (5.4)	3.5 (4.9)
Former	10.7 (0.9)	10.5 (0.9)	2.2 (0.9)	2.4 (0.9)	6.7 (7.8)	7.4 (8.6)
Never	10.6 (0.9)	10.5 (0.9)	2.4 (0.9)	2.5 (1.0)	6.9 (8.1)	7.7 (8.5)

Table 4.11. (continued).

Student group	Average grade level when first accelerated learning option course was taken		Average number of years enrolled in accelerated learning option courses		Average number of credits earned in accelerated learning option courses during high school	
School year	**2014/15**	**2017/18**	**2014/15**	**2017/18**	**2014/15**	**2017/18**
School urbanicity						
Urban/suburban	10.6	10.5	2.2	2.4	7.4	8.0
	(0.9)	(0.9)	(0.9)	(0.9)	(8.6)	(9.0)
Fringe	10.7	10.4	2.2	2.6	4.8	6.3
	(0.9)	(1.0)	(0.9)	(1.0)	(4.7)	(7.0)
Distant	10.8	10.9	2.1	2.1	4.2	5.5
	(0.9)	(0.9)	(0.8)	(0.9)	(3.7)	(5.8)
Remote	10.5	10.7	2.3	2.1	4.2	5.1
	(1.0)	(0.9)	(1.0)	(1.0)	(5.3)	(5.7)

Note: sample includes 45,259 students in 2014/15 and 53,274 students in 2017/18. Standard deviations in parentheses.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2014/15 and 2017/18.

4.2.2 Under- and Overrepresentation in Accelerated Learning Option Courses

While gaps among students in different demographic groups in accelerated learning option course participation are clear in the previous analyses, it is helpful to understand whether these gaps rise to the level of under- or overrepresentation in accelerated learning option courses. To do so, I established thresholds for under- and overrepresentation using the risk ratios described in section 4.1.4. The results of this analysis show that several groups of students are underrepresented in accelerated learning option courses relative to their peer group (table 4.12). For example, relative to White students, American Indian/Alaska Native students have a risk ratio of 0.61 to enroll in an accelerated learning option course in 2017/18, which falls outside the "representative range" of 0.70 to 1.23. In contrast, Asian students are overrepresented in accelerated learning option courses relative to the participation rate of White students.

Students in fringe and distant schools increased their representativeness in accelerated learning option courses relative to students in urban and suburban schools between 2014/15 and 2017/18. Students in distant schools were no longer underrepresented and students in fringe schools achieved parity with students in urban and suburban schools with risk ratios near 1.

Nevertheless, students who had experienced poverty, current English learners, and students attending remote schools were largely underrepresented among all accelerated learning option courses and in STEM accelerated learning option courses. The consistency of this result across all analyses suggests there are systematic barriers to advanced course participation for these student groups that existing structures and policies in Washington's educational system have not been able to overcome.

Table 4.12. Risk ratios for participating in accelerated learning option courses, 2014/15 and 2017/18

	All accelerated learning option courses		**STEM accelerated learning option courses**	
School year	**2014/15**	**2017/18**	**2014/15**	**2017/18**
Representative risk ratio	**0.67 to 1.24**	**0.70 to 1.23**	**0.41 to 1.28**	**0.53 to 1.26**
Student group				
Female, relative to male	1.15	1.13	1.03	1.02
Race/ethnicity, relative to White				
American Indian/Alaska Native	0.66	0.62	0.52	0.48
Asian	1.47	1.43	1.87	1.72
Black	0.82	0.89	0.65	0.69
Hispanic/Latino	0.75	0.83	0.59	0.68
Two or more races	1.01	1.04	0.96	0.97
Ever eligible for free or reduced-price lunch	0.57	0.62	0.42	0.48
English language status, relative to never English learners				
Current	0.51	0.55	0.41	0.43
Former	0.92	1.07	0.89	1.03
School urbanicity, relative to urban/suburban schools				
Fringe	0.77	1.01	0.58	1.11
Distant	0.50	0.73	0.36	0.76
Remote	0.56	0.54	0.36	0.41

Note: STEM (science, technology, engineering and mathematics) includes math, life and physical sciences, computer science, health care science, and engineering courses. Orange-shaded cells indicate overrepresentation and blue-shaded cells indicate underrepresentation compared to the referent group.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2009/10–2017/18.

Another way to understand the degree of under- and overrepresentation in accelerated learning option courses is to compare the percentages of students enrolled in accelerated learning option courses in each group against the state average. In figure 4.1, the green dashed horizontal lines indicate the representative range for participation in any accelerated learning option course in 2017/18. The green bars represent each student group's participation rate. Results that fall between the two green lines are considered representative. Results that fall above or below this bandwidth are shaded a darker color to indicate the student group is under- or overrepresented in accelerated learning option courses. The blue dashed lines and bars illustrate patterns among STEM accelerated learning option course-taking.

Relative to the state average, few groups are under- or overrepresented in accelerated learning option courses. Those that fall beyond the representative thresholds typically do so by a small amount, such as American Indian/Alaska Native students, students who were never eligible for free or reduced-price lunch, and, with respect to STEM accelerated learning option course participation, students in remote schools. Other groups, such as Hispanic/Latino and students in distant schools, participate at rates on the verge of underrepresentation. Asian students, in contrast, are clearly overrepresented in accelerated learning option courses. Current English learners and students in remote schools (in the case of all accelerated learning option courses) are also well underrepresented in accelerated learning option course participation

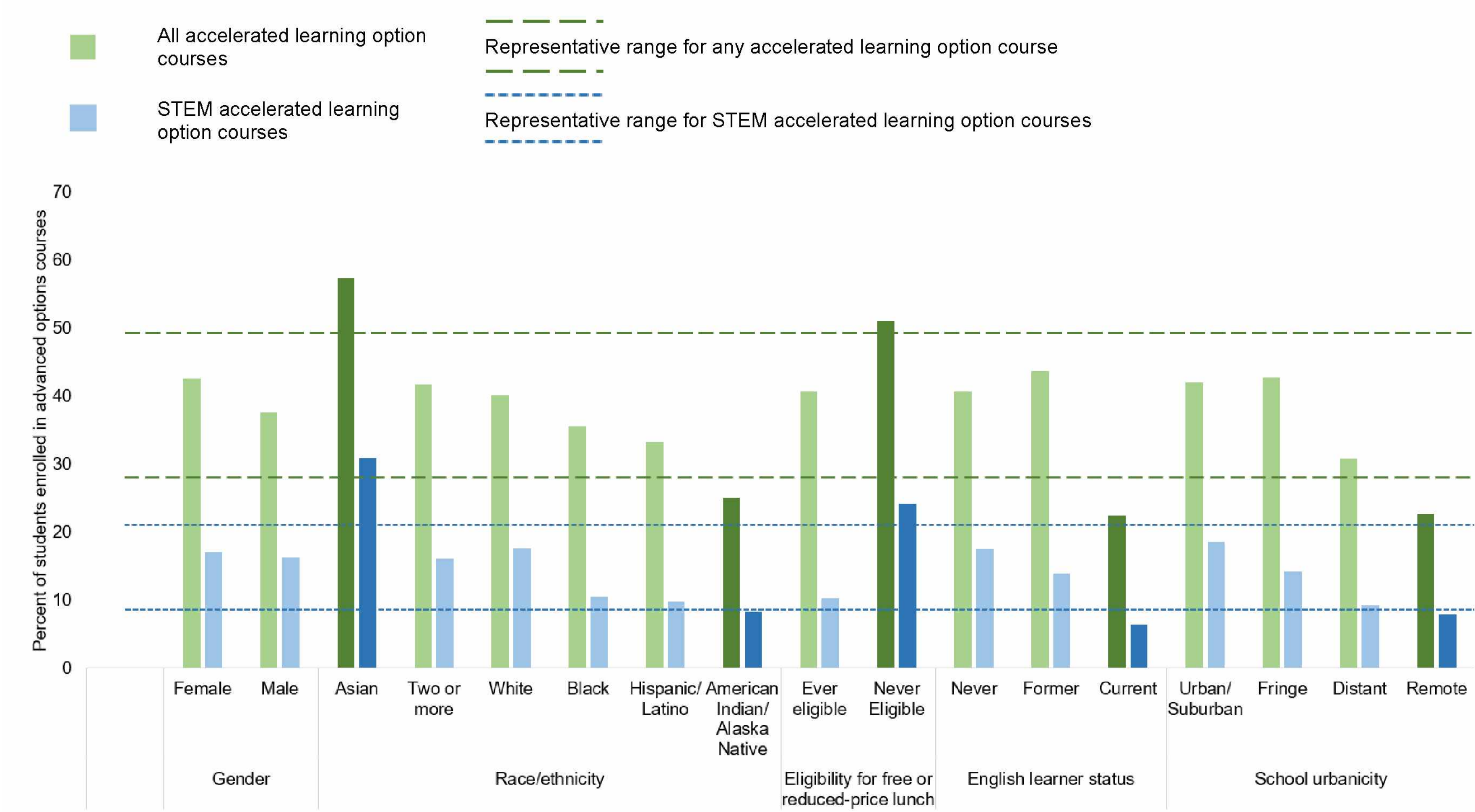

Figure 4.1. Under- and overrepresentation in accelerated learning option courses, 2017/18

Note: Bars shaded a darker color are either under- or overrepresented in accelerated learning option courses.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2017/18

4.3 Discussion

The findings in this chapter show that participation in accelerated learning option courses is on the rise—a trend that leaves no student group under study behind. However, while all groups are making progress in expanding participation in accelerated learning option courses, large disparities persist for students who have experienced poverty, students who are acquiring or recently acquired academic English proficiency in high school, and for students living in remote areas. Each of these student groups presents unique challenges to expanding their participation in accelerated learning option courses.

There are no easy interventions to remove barriers to participation in accelerated learning option courses for these student groups in a way that could quickly close gaps. In fact, real drivers of change may be fall outside education systems and the policies that guide them. For example, alleviating the conditions of poverty that frustrate academic growth throughout students' educational careers may involve changes to economic, tax, housing, food, and health care policies. In the absence of a holistic approach to improving students' capacity and readiness to learn from early on, it is likely that disparities will persist indefinitely.

On the bright side, education leaders have more agency to make changes to educational systems and policies that matter for English language acquisition and educational opportunities in remote rural schools. State supports prioritize best practices in English language proficiency, bilingual, and migrant education programs (Office of Superintendent of Public Instruction, 2019b), while local and regional programs focus efforts on accelerating time to proficiency (Whealdon & Ghahremani, 2018). While fewer efforts currently focus on strengthening rural education, the state provides additional funding and flexibility for using funds to rural schools to address unique challenges of serving small communities in remote, sparsely populated areas (Office of Superintendent of Public Instruction, 2019c).

This chapter also found that students who take accelerated learning option courses taken on a high school campus—AP, CP, CHS, and IB—take courses that typically count towards a postsecondary degree, such as English, biology, chemistry, history, world languages, and calculus. Physical education courses, on the other hand, usually do not apply towards a degree. Therefore, the frequency of physical education courses taken on a college campus suggests that some students use the Running Start program to meet a high school graduation requirement rather than to decrease the cost and time necessary to achieve a postsecondary credential. School district and state education leaders may consider ways to help students meet physical education graduation requirements through options provided at the secondary level so that investments in dual enrollment courses can give students a true "running start" on a college degree.

An important area for future research is the study of how high school accelerated learning options choices relate to postsecondary outcomes. A better understanding of how some courses may be more predictive of successful college outcomes than others could support curriculum development among districts and schools and could help inform advising decisions for individual students. In addition, evaluating interventions to improve preparedness for and participation in accelerated learning option courses among underrepresented groups can support identification of practices and policies that help narrow disparities. Finally, future analyses may be able to analyze outcomes among participants in Tech Prep courses.

4.4 Limitations

The analyses presented in this chapter are descriptive and correlational. They provide evidence of the relationships between accelerated learning option course-taking and student characteristics, but they do not establish causality. That is, in the absence of a clear counterfactual or comparison group, the findings suffer from selection bias. Therefore, they should be interpreted cautiously, as patterns and trends that form the foundation for further analysis, as in chapters 5 and 6.

Due to the lack of standardization in course transcript data submitted to the state and the many judgement calls that needed to be made to correct data entry errors and classify each course appropriately, the results should not be considered absolutely precise. A reduction in precision is more likely to impact CHS and Running Start courses, since AP, IB, and CP courses more often included their course type as a prefix or suffix in the course title (e.g., AP Biology or Theory or Knowledge IB). Although the extent of enrollment is never likely to be calculated with exact precision at the state level with existing data, patterns in participation should be consistent within a margin of error. In addition, as mentioned in section 4.2, Tech Prep courses were not studied due to difficulties in accurately identifying participants.

5.0 Impact of HB 1546 on Underrepresented Students' Participation in Dual Credit Courses

This analysis examines how CHS subsidies awarded as a result of HB 1546 impacted enrollment in CHS courses and the number of high school credits earned in those courses. To estimate the impact of HB 1546 on participation in CHS courses, I used a regression discontinuity (RD) approach (Shadish, Cook, & Campbell, 2002). I describe this method in detail in section 5.1, which is followed by a presentation of the results, a discussion of the implications and limitations of the analysis to consider when interpreting the findings.

5.1 Methods

This study employs a RD design to analyze the impact of HB 1546's CHS subsidies on dual credit course-taking for students attending schools just above the eligibility cutoffs relative to students attending schools just below the eligibility cutoffs. The criteria to receive funding under HB 1546 facilitates a RD design since assignment to treatment conditions for students attending schools just above and just below the cutoffs can be considered due to random variation. For these students, the analysis can provide causal estimates of the impact of their school's eligibility for CHS subsidies.

Regression discontinuity hinges on several assumptions (Imbens & Lemiux, 2008). First, the forcing variables that assign subjects to the intervention must meet several criteria. They must be numerical variables in which subjects with values at or above (or below) a cutoff value are assigned to the intervention group whereas those on the other side of the cutoff are assigned to the comparison group (i.e., at least 20 miles from a college with a Running Start program, enrollment of fewer than 300 students, or at least 50 percent of students eligible for free or reduced price lunch). The forcing variables must also be ordinal or continuous (miles, number of students, and percentage points). Further, the study cannot have a confounding factor as a component of the study design that is perfectly aligned with either the intervention or the comparison group. Finally, the forcing variables used to calculate impacts must be the actual forcing variables, not a proxy or estimated forcing variables.

The forcing variables for this study meet the above criteria with one complication: there are three of them. Specifically, to be eligible for Tier 1, schools must be at least 20 miles from the nearest college that offers Running Start courses. To be eligible for Tier 2, schools must not qualify for Tier 1 and the regular high schools (i.e., not alternative or special placement) in the school district must have 300 or fewer students enrolled in grades 9–12. To qualify for Tier 3, a school must not meet Tier 1 or Tier 2 eligibility criteria and must have at least 50 percent of its students eligible for free or reduced-price lunch. Within Tier 3 schools, only students who are eligible for free or reduced-price lunch may receive subsidies for CHS credits. To accommodate for multiple forcing criteria, I use a multiple rating-score frontier RD method to estimate the local average treatment effect for each frontier separately (Reardon & Robinson, 2012). This analytic strategy yields estimates that are easy to interpret. At the $R^{A|D}$ frontier, it is the local average treatment effect (LATE) of eligibility for Tier 1 relative to ineligibility for subsidies. At the $R^{B|D}$ frontier, it is the LATE of eligibility for Tier 2 relative to ineligibility for subsidies, and at the $R^{C|D}$ frontier, it is the LATE of eligibility for Tier 3 relative to ineligibility for subsidies (figure 5.1). When interpreting the effects of the HB 1546 policy, it is easier to discern impacts of eligibility for each tier of subsidies without having to condition the results on being eligible for a different tier of funding. However, since schools eligible for funding under a different tier are excluded from the comparison sample whether or not they received the treatment, a limitation of this approach is that it restricts the sample size and statistical power available for comparison at each frontier. For example, when measuring the impact of attending a school eligible for Tier 1 subsidies, students attending schools eligible for Tier 2 and Tier 3 subsidies are excluded from the analysis.

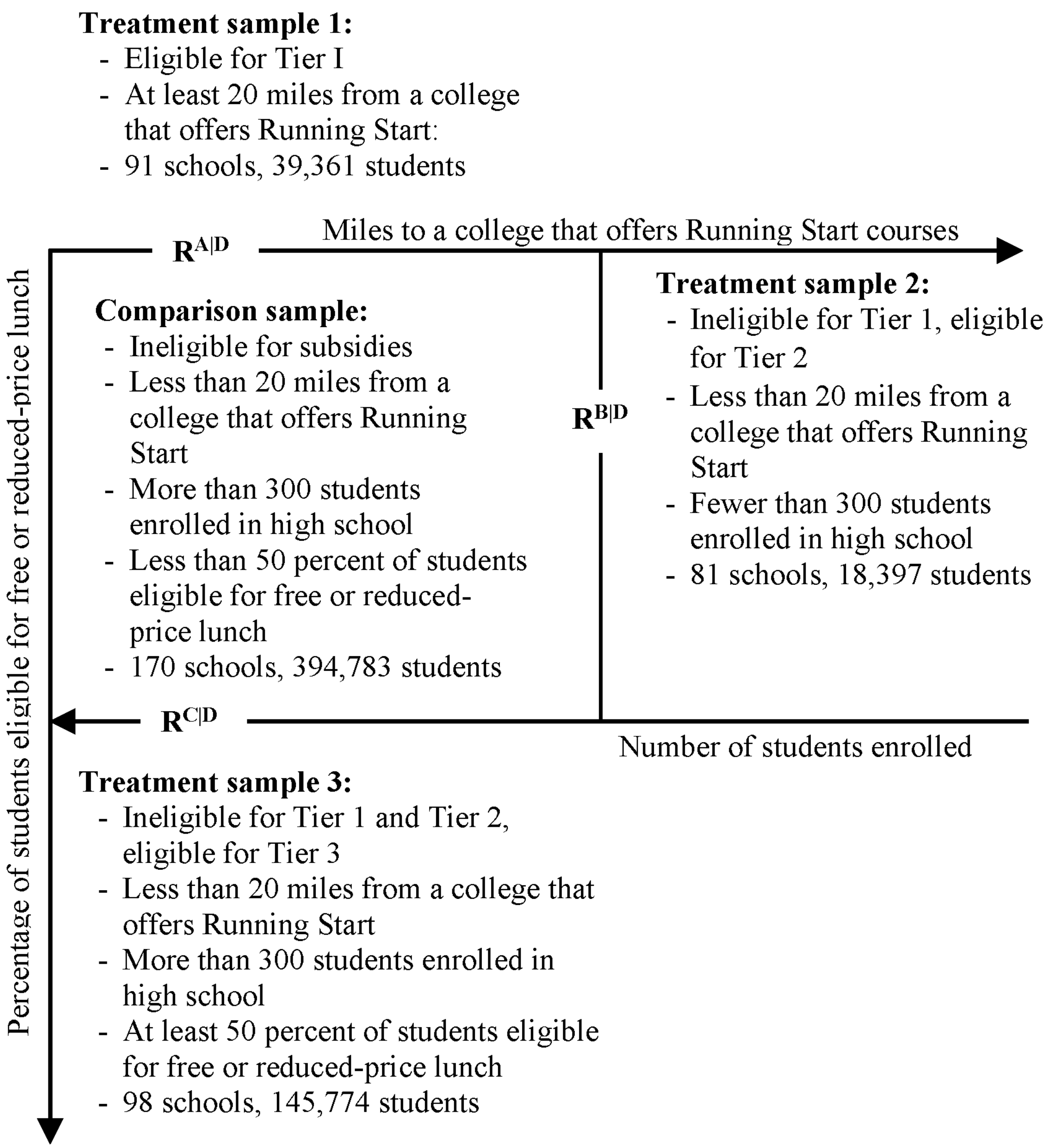

Figure 5.1. Illustration of regression discontinuity design with three frontiers.

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18

Another assumption RD designs must meet is that eligibility for the intervention should predict receipt of the treatment. In this case, schools that are eligible should receive subsidies, with few or no “no shows” (i.e., eligible schools that do not apply for subsidies). Conversely, schools that are ineligible for treatment should not receive subsidies, with few to no “crossovers” (i.e., ineligible schools that manage to receive subsidies). Among schools eligible for Tier 1—excluding those with no history of offering CHS courses—there were several no shows (figure 5.2). However, among schools ineligible for CHS subsides under any of the three criteria, none received subsidies. The probability of receiving CHS subsidies among Tier 1 eligible schools was over 0.8 near the cutoff of 20 miles from a college that offers Running Start. The probability of receiving CHS subsidies decreased to about 0.7 for schools that were located 90 miles from a college that offered Running Start. Among the three tiers, Tier 1 eligible schools had the highest probability of being awarded subsidies. This makes sense, given administrators were aware they had first priority for funding and were certain of their eligibility, which was based on an objective and immutable measure (miles to a college that offers Running Start). In contrast, eligibility was not strictly certain among schools eligible under Tier 2 and Tier 3 criteria. In addition to knowing they were not the top priority for receiving a fixed amount of CHS subsidies allocated by the state legislature, their eligibility was dependent on factors outside the school’s control, such as how many students would enroll and how many of them would be eligible for free or reduced-price lunch.

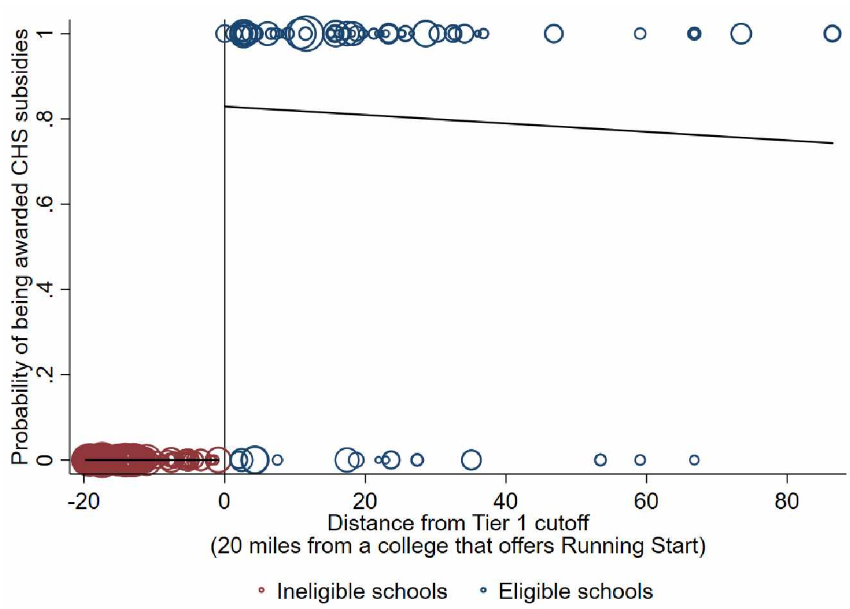

Figure 5.2. Probability of being awarded College in the High School (CHS) subsidies by miles from a college that offers Running Start, 2016/17–2017/18.

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

Like Tier 1 schools, some schools eligible for Tier 2 did not apply for subsidies, but no ineligible schools were awarded subsidies under Tier 2 (figure 5.3). The probability of being awarded CHS subsidies was generally lower for Tier 2 eligible schools across values of the student enrollment forcing variable than it was for Tier 1 eligible schools. Further, schools with very few students enrolled were less likely than schools closer to the cutoff of 300 students to apply for subsidies. In addition to factors described above, possible explanations for this pattern include scarcity of qualified faculty available to teach CHS courses in districts with fewer than 100 high school students and uncertainty around how many students may be interested in taking CHS courses and meet the local criteria to do so. As student enrollment approaches the cutoff, the probability of receiving CHS subsidies increases to nearly 0.8, which is comparable to the probability of schools near the Tier 1 cutoff being awarded subsidies.

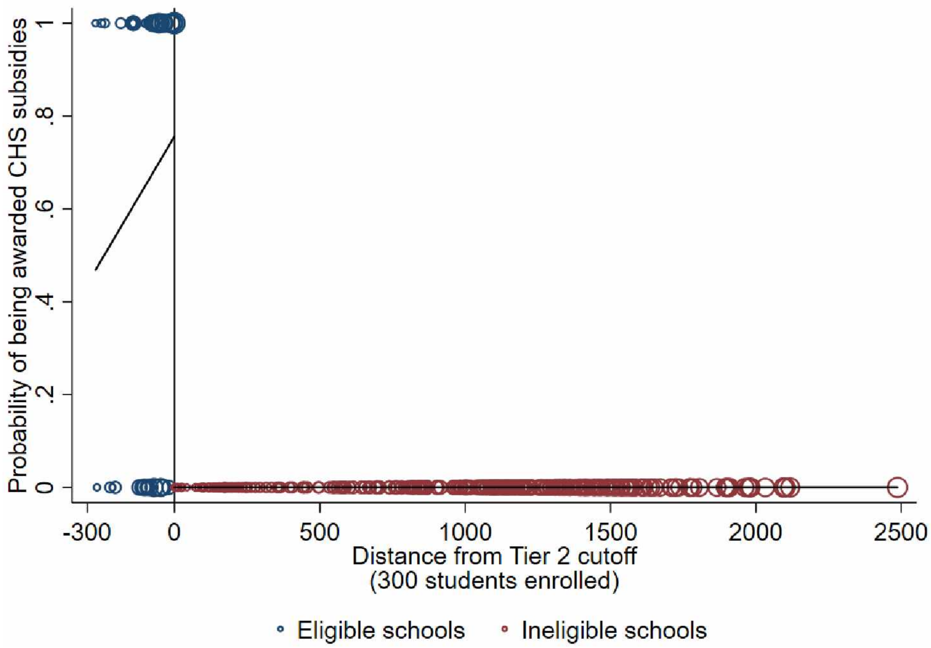

Figure 5.3. Probability of being awarded College in the High School (CHS) subsidies by student enrollment, 2016/17–2017/18.

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

Finally, as with Tier 1 and Tier 2 schools, no ineligible schools received CHS subsidies under Tier 3 (figure 5.4). The prevalence of no shows is highest among Tier 3 schools, however. In particular, schools near the cutoff of 50 percent eligibility for free or reduced-price lunch have a lower probability of applying for subsidies than Tier 1 and Tier 2 schools near their respective cutoffs (see figures 5.2 and 5.3). Tier 3 eligible schools near the cutoff also have a lower probability of applying for subsidies than Tier 3 schools that have well above 50 percent of students eligible for free or reduced-price lunch.

This pattern can be explained by Tier 3 school administrators' uncertainty of their eligibility for subsidies. First, small changes in student enrollment or in students' family circumstances could change eligibility for schools near the cutoff. Furthermore, some school leaders were not certain they would receive CHS subsidies even if their school were eligible.

Specifically, some administrators of Tier 3 schools reported that "they did not apply for subsidies because they knew that, without being eligible for the top tiers of priority, there would not be funding available to meet their request" (Washington Student Achievement Council, 2016). Complicating the issue, legislative allocations were not known until late July in the first year of policy implementation, after the deadline for requests for subsidies had passed.

In sum, barriers to implementing CHS programs, applying for subsidies, and imperfect information around eligibility for subsidies likely decreased the reach of the policy to some of its target populations of students who are underrepresented in accelerated learning option courses. Its impact on all eligible students, therefore, may be underestimated. In addition, because eligible schools in each tier did not apply for subsidies, I conduct a "fuzzy RD" through a two stage least squares (2SLS) analysis as well as an intent to treat (ITT) analysis. Both models are explained in more detail in section 5.1.2.

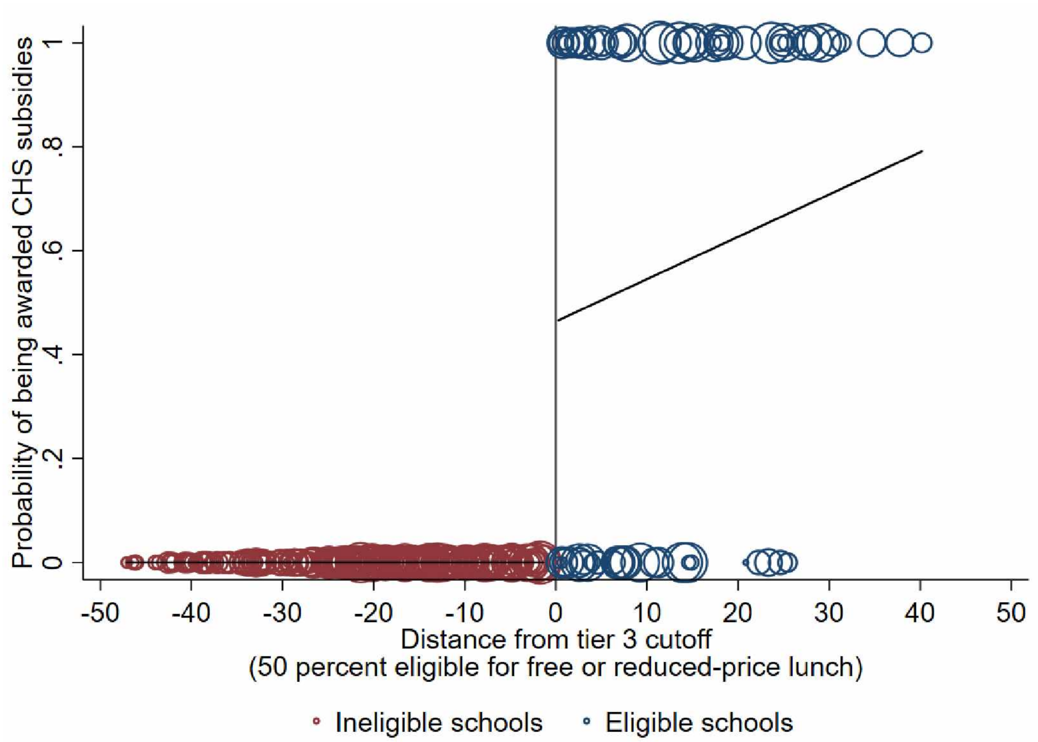

Figure 5.4. Probability of being awarded College in the High School (CHS) subsidies by percentage of students eligible for free or reduced-price lunch, 2016/17–2017/18.

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

A third assumption of RD designs is that there was no manipulation of assignment to the intervention. This could happen if a family chooses to move to the neighborhood of an eligible school on the basis that their children's CHS credits would be subsidized. However, due to uncertainty about eligibility and about whether each school applied for subsidies in a given year, coupled with hardships involved in moving to a different community, nonrandom student sorting across ineligible and eligible schools is extremely unlikely. Manipulation of assignment could likewise happen if a school administrator purposefully altered enrollment or program eligibility records to make a school eligible or ineligible. However, not only are these records rigorously audited, the data are collected for a plethora of other local, state, and federal programs. Misreporting them to gain advantage in one area could penalize the school in another (e.g., lowering student enrollment may qualify the school for Tier 2 CHS subsidies, but will also lower per pupil funding). Given the unlikelihood of manipulation by students, schools, or other local and state officials, manipulation of assignment is extremely unlikely. Any variation in student characteristics that are not related to the outcomes across the eligibility cutoffs should be unrelated to eligibility. Evidence of this lack of manipulation is presented below, at the conclusion of the presentation of the results for each tier.

5.1.1. Identifying a Bandwidth Around Each Eligibility Criteria

The choice of bandwidth around the cutoff in an RD design affects estimates of impact and is therefore a vital step in the RD analytic process. In this section I describe my approach to selecting bandwidths around each of the three cutoffs. The provision of funding is one of three unknown deterministic functions: $F_j = 1(D_j \geq D_{20})$, the distance from a college that offers Running Start courses being at least 20 miles, $F_j = 1(S_j \leq S_{300})$, the size of the school being less than 300 students, or $F_j = 1(P_j \geq P_{50})$, the percentage of students eligible for free or reduced-price lunch being at least 50 percent. Because the exact functional form of the relationship between enrollment in a dual credit course is unknown around the cutoff scores, I examined this relationship over the range of values using a nonparametric smoothing approach. To estimate the probability of receiving funding from HB 1546, represented by δ_{funded}, I used observations above the cut score for Tier 1 (20 miles from a college offering Running Start courses), below the cut score for Tier 2 (300 or fewer students enrolled), and above the cut score for Tier 3 (50 percent of students eligible for free or reduced-price lunch). To estimate $\delta_{unfunded}$, the probability of not receiving funding from HB 1546, I use observations above the cutoff for Tier 2 and below the cutoffs for Tier 1 and Tier 3.

An important complication is that the parameters of interest, δ_{funded} and $\delta_{unfunded}$, are estimated at a boundary point. As standard nonparametric smoothing strategies have poor boundary properties, I used the nonparametric approach recommended by Hahn, Todd, and Van der Klaauw (2001) and Porter (2003). This method uses local linear regressions (Fan & Gijbels, 1996) to estimate the left and right limits of the discontinuity, where the difference between the two is the estimated treatment impact (Imbens & Lemieux, 2008):

$$\min_{\alpha,\beta,\tau,\gamma} \sum_{i=1}^{N} 1\{c-h \le X_i \le c+h\} \cdot (Y_i - \alpha - \beta \cdot (X_i - c) - \tau \cdot W_i - \gamma \cdot (X_i - c) \cdot W_i)^2 \quad (5.1)$$

where c is the cutoff value, h is the rectangular kernel bandwidth on either side of the cutoff, N is the number of observations above and below the cutoff, X is the value of the forcing variable of student i's school with $X_i \in [c, c+h]$ and $X_i \in [c-h, c)$, W is an indicator for whether student i attended a school that received funding, α is a constant term, and β is a coefficient for $X - c$. In all cases, I adjusted standard errors to account for the discrete nature of the forcing variables by clustering observations at each score point, as recommended by Lee & Card (2008).

I conducted smoothing within a linear probability specification of the standard regression discontinuity design. Specifically, at each point (i.e., each mile from a college offering Running Start courses, each number of students enrolled, or each percentage point of students eligible for free or reduced-price lunch) I fit local linear regression functions, with a rectangular kernel and observations that fall within a narrow bandwidth, h, around the cutoff in question. I then predicted the probability of enrolling in at least one CHS course at that cutoff. By sliding this bandwidth smoothly throughout the data range, I generated locally predicted values at each value of the forcing variables. Linking them together created a smoothed nonparametric regression line.

The extent of smoothing depends on the choice of bandwidth, h. I used cross-validation to select an optimal bandwidth, h^*, based on all the data and a statistical fit criterion (Imbens & Lemieux, 2008). I use the criterion:

$$CV_Y^{\delta}(h) = \frac{1}{N}\sum_{i:qX,\delta,l \leq qX,1-\delta,r}(Y_i - \hat{\mu}(X_i))^2 \quad (5.2)$$

where δ is the quantile of the empirical distribution of X for the subsample $X_i < c$, and $q_{X,\delta,r}$ is the δ quantile of the distribution of X for the subsample with $X_i \geq c$. The modified cross-validation choice for the bandwidth is

$$h_{CV}^{\delta,opt} \min_{h} CV_Y^{\delta}(h) \quad (5.3)$$

This process yielded bandwidths of 13 miles for Tier 1, 65 students for Tier 2, and 6 percentage points for Tier 3. I conducted sensitivity analyses by choosing different bandwidths to see if the results are robust to other choices of bandwidth.

5.1.2 Estimation Strategy

After choosing bandwidths for each forcing variable, I estimated δ_{funded} and $\delta_{unfunded}$ by fitting a linear probability model using observations within h^* on the appropriate side of the discontinuity:

$$p(enrollment = 1) = \alpha + C_{ij} + \beta_2 F_j \quad (5.4)$$

where $p(enrollment)$ is the probability that student i in school j will enroll in at least one CHS course during the school year, C is an unknown smooth function of the criterion under examination, and F is the impact of funding from HB 1546.

As shown in figures 5.2, 5.3 and 5.4, some schools that were eligible for CHS subsidies did not apply for them (e.g., they were “no shows” for the treatment). This classifies the analytic approach as a “fuzzy RD.” Since there was noncompliance on the side of eligible schools, I estimate treatment effects two ways. First, I use a 2SLS process to estimate the treatment effect on schools that received CHS subsidies. Then, I estimated treatment effects for all schools within the bandwidth, regardless of whether they were awarded CHS subsidies (an ITT model). I apply both strategies in the analysis, each of which has advantages and drawbacks. In 2SLS, the first stage predicts the receipt of subsidies as a function of eligibility:

$$Subsidies_{ij} = \gamma_0 + \gamma_1 Eligible_j + \gamma_2 DistancetoCutoff_j + \gamma_3 DistancetoCutoff_j^2 + \gamma_4 Eligible \times DistancetoCutoff_j + \gamma_5 Eligible \times DistancetoCutoff \times DistancetoCutoff_j^2 + \boldsymbol{X}_{ij} + \mu_{ij} \qquad (5.5)$$

where *Subsidies* denotes the school that student *i* attended received CHS subsidies, *Eligible* indicates whether student *i*'s school was eligible for CHS subsides based on the value of the forcing variable under study, *DistancetoCutoff* represents the value of the forcing variable assigned to student *i*'s school. I estimate a simple linear model with covariates (estimating γ_1–γ_3) and a quadratic model with interactions that includes a square term for *DistancetoCutoff* and interactions between *Eligible* and *DistancetoCutoff* and among *Eligible*, *DistancetoCutoff*, and the square of *DistancetoCutoff*. Present in all models is a vector of student-level covariates, $\boldsymbol{X}$, that includes gender, race/ethnicity, English learner status (current, former, or never), indicators for whether student *i* was ever eligible for special education or migrant student services, whether student *i* was ever eligible for free or reduced-price lunch, grade 8 English language arts and math state assessment scores, standardized to have a mean of 0 and a standard deviation of 1 within school year and test type, grade 9 grade point average, whether student *i* had ever been suspended or expelled before grade 10, and whether student *i* attended a single school in grade 9 (a measure of mobility). Finally, μ represents a random error term, clustered by school and assumed to be independently and identically distributed, based on a normal distribution with a mean zero and variance σ^2.

The second stage equation estimates the local average treatment effect of the predicted probability of receiving subsidies on CHS course-taking outcomes:

$$Y_{ij} = \beta_0 + \beta_1 \widehat{Subsidies}_j + \beta_2 DistancetoCutoff_j + \beta_3 DistancetoCutoff_j^2 + \beta_4 Eligible \times DistancetoCutoff_j + \beta_5 Eligible \times DistancetoCutoff \times DistancetoCutoff_j^2 + \boldsymbol{X}_{ij} + \varepsilon_{ij} \tag{5.6}$$

where Y_{ij} represents a CHS course-taking outcome for student i in school j, $\widehat{Subsidies}$ represents the predicted probability of receiving subsidies given eligibility for CHS subsidies from stage 1 and other variables are defined as above. ε represents a random error term, clustered by school and assumed to be independently and identically distributed, based on a normal distribution with a mean zero and variance σ^2.

The ITT model estimates the effect of eligibility for CHS subsidies directly on CHS course-taking outcomes, disregarding whether eligible schools received subsidies. The model is specified as:

$$Y_{ij} = \beta_0 + \beta_1 Eligible_j + \beta_2 DistancetoCutoff_j + \beta_3 DistancetoCutoff_j^2 + \beta_4 Eligible \times DistancetoCutoff_j + \beta_5 Eligible \times DistancetoCutoff \times DistancetoCutoff_j^2 + \boldsymbol{X}_{ij} + \varepsilon_{ij} \tag{5.7}$$

where Y_{ij} represents a CHS course-taking outcome for student i in school j, *Eligible* indicates whether student i's school was eligible for CHS subsides based on the forcing variable under study, and other variables as described previously. As with the 2SLS approach, both linear models and quadratic models with interactions are estimated. ε represents a random error term, clustered by school and assumed to be independently and identically distributed, based on a normal distribution with a mean zero and variance σ^2.

5.1.3 Sample

Analytic samples were drawn from a starting sample of 403,124 students in grades 10–12 attending Washington state's regular public high schools between 2016/17 and 2017/18—the years in which schools were awarded CHS subsidies based on tier status alone. (In the transition year, 2015/16, schools that previously received funds for Running Start were prioritized for CHS subsidies.) Students in Tier 3 schools who were not eligible for free or reduced-price lunch, and therefore not eligible to receive subsidies, were excluded from the analysis (34,001 students). They were likewise excluded from the sample of ineligible schools when estimating treatment effects for Tier 3 schools.

The sample further excludes two types of schools. First, it excludes 12 schools that were not eligible for funding as a whole, but that enrolled students who were awarded funding as individuals because their home address was more than 20 miles from a college that offered Running Start courses. Data on students' home addresses was not available; therefore, it was not possible to use distance from students' residence to a college that offers Running Start as a forcing variable or even as a control variable in models. The sample also excludes 156 schools that have no history of offering college in the high school courses—18 that qualified for CHS subsidies under one of the three tiers and 138 that were ineligible for CHS subsidies. Program development requires local investments and secondary-postsecondary partnerships that the policy did not address. While the offer to reimburse college credits may entice eligible schools to begin developing a program, the policy prioritizes schools whose students can immediately benefit from funding to earn college credits from courses offered in their high schools. Nevertheless, these exclusions affect the generalizability of the results. They neither apply to students receiving funding when their school is ineligible nor to schools that have no history of offering CHS courses.

As shown in table 5.1, the policy targets schools that serve underrepresented students. Eligible schools tend to have higher percentages of students of color, and students who may face challenges associated with poverty, English proficiency, high mobility, and special needs. Apart from attending a distant, small, or high-poverty school, they may face additional barriers to enrolling in advanced coursework, as measured by their higher rates of chronic absenteeism and exclusionary discipline as well as lower grade 8 state assessment scores.

Table 5.1. Regression discontinuity sample characteristics prior to trimming.

Characteristic	Eligible for Tier 1	Eligible for Tier 2	Eligible for Tier 3[a]	Ineligible
Number of students	17,243	5,231	72,225	201,648
Number of schools	55	25	44	121
Percentage of students in each group				
Male	52.0	51.6	51.4	51.2
	(50.0)	(50.0)	(50.0)	(50.0)
American Indian/Alaska Native	3.1	3.4	5.0	1.8
	(17.3)	(17.3)	(18.1)	(13.4)
Asian	0.8	1.3	6.5	10.6
	(8.7)	(11.2)	(24.7)	(30.8)
Black	0.4	0.8	9.4	4.2
	(6.7)	(8.7)	(29.1)	(20.0)
Hispanic/Latino	38.3	20.7	49.0	13.4
	(48.6)	(40.5)	(34.1)	(34.1)
Two or more races	2.5	4.3	4.7	7.3
	(15.7)	(20.4)	(21.2)	(26.0)
White	54.9	69.6	25.4	62.7
	(50.0)	(46.0)	(43.5)	(48.4)
Ever eligible for free or reduced-price lunch	78.0 (41.5)	68.9 (46.3)	100 (0)	45.4 (49.8)
Ever eligible for English learner services	32.5 (46.9)	16.0 (36.7)	51.1 (50.0)	15.3 (36.0)
Ever eligible for migrant student services	12.7 (33.2)	7.2 (25.8)	12.4 (33.2)	0.9 (9.5)
Ever eligible for special education	19.7	21.6	20.9	17.5
	(39.8)	(41.2)	(40.7)	(38.0)
Chronically absent in grade 9[b]	23.5	22.4	33.3	17.3
	(42.4)	(41.8)	(47.1)	(37.8)
Ever suspended or expelled before grade 10	6.3 (24.3)	8.5 (27.9)	9.2 (28.9)	4.2 (20.0)
Attended one school in grade 9	94.5	93.8	90.9	93.9
	(22.7)	(24.1)	(28.7)	(23.9)
Average among students in each group				
Grade 8 English language arts state assessment scores (standardized)	–0.216 (0.962)	–0.155 (0.940)	–0.460 (0.954)	0.188 (0.976)
Grade 8 math state assessment scores (standardized)	–0.206 (0.912)	–0.150 (0.895)	–0.411 (0.922)	0.233 (1.000)
Grade 9 grade point average	2.80	2.78	2.37	2.85
	(0.90)	(0.93)	(1.03)	(1.06)

[a] Since CHS subsidies are limited to students eligible for free or reduced-price lunch in Tier 3 schools the analytic sample is likewise limited.
[b] Chronic absenteeism is defined as attending school for fewer than 162 days (or less than 90 percent of school days).
Note: Standard deviations are in parentheses.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

Estimation of impacts along each of the three frontiers included subsamples of students who attended schools near the cutoff for each eligibility tier and that were not eligible for subsidies under another tier. The trimmed samples tend to have more similar characteristics than untrimmed samples (table 5.2). However, variation remains. For this reason, it is necessary to include these pretreatment covariates in estimates of treatment effects.

Table 5.2. Regression discontinuity sample characteristics after trimming.

	7–33 miles from a college that offers Running Start		235–365 students enrolled		44–56 percent free or reduced-price lunch[a]	
Characteristic	**Eligible for Tier 1**	**Ineligible**	**Eligible for Tier 2**	**Ineligible**	**Eligible for Tier 3**	**Ineligible**
Number of students	8,995	31,844	3,471	1,399	15,270	10,684
Number of schools	20	29	12	4	17	18
Percentage of students in each group						
Male	51.6	51.4	51.1	50.4	51.1	52.5
	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)
American Indian/	2.4	2.0	1.5	17.5	4.8	4.6
Alaska Native	(15.3)	(14.0)	(12.3)	(38.0)	(21.4)	(5.1)
Asian	0.8	5.1	1.3	0.6	5.8	4.1
	(8.6)	(22.1)	(11.4)	(7.6)	(23.4)	(19.9)
Black	0.5	1.4	0.8	0.7	7.6	6.6
	(7.4)	(11.9)	(8.9)	(8.3)	(26.5)	(24.9)
Hispanic/Latino	36.2	11.5	23.8	11.8	36.6	34.0
	(48.1)	(32.0)	(42.6)	(32.3)	(48.1)	(47.4)
Two or more races	2.2	5.5	5.5	7.8	6.1	6.0
	(14.8)	(22.7)	(22.8)	(26.8)	(23.8)	(23.8)
White	57.8	74.4	67.1	61.6	39.1	44.6
	(49.4)	(43.7)	(47.0)	(48.6)	(48.8)	(49.7)
Ever eligible for free	75.6	45.7	70.2	74.2	100	100
or reduced-price lunch	(43.0)	(49.8)	(45.7)	(43.8)	(0.0)	(0.0)
Ever eligible for	29.6	9.8	19.2	9.5	35.9	34.7
English learner services	(45.7)	(29.4)	(39.4)	(29.4)	(48.0)	(47.6)
Ever eligible for	9.8	1.6	7.4	4.6	7.1	11.1
migrant student services	(29.7)	(12.7)	(26.2)	(21.1)	(25.7)	(31.4)
Ever eligible for	19.6	18.8	20.2	21.5	23.1	24.1
special education	(39.7)	(39.0)	(40.2)	(41.1)	(42.1)	(42.8)
Chronically absent in	24.6	17.9	20.9	24.8	36.1	33.7
grade 9[b]	(43.1)	(38.4)	(40.7)	(43.2)	(48.0)	(47.3)

Table 5.2. (continued).

Characteristic	7–33 miles from a college that offers Running Start: Eligible for Tier 1	Ineligible	235–365 students enrolled: Eligible for Tier 2	Ineligible	44–56 percent free or reduced-price lunch[a]: Eligible for Tier 3	Ineligible
Ever suspended or expelled before grade 10	6.2 (24.1)	4.2 (20.1)	9.9 (29.8)	9.3 (29.1)	9.6 (29.5)	9.1 (28.7)
Attended one school in grade 9	94.3 (23.2)	95.4 (21.0)	93.9 (23.9)	91.8 (27.5)	90.1 (29.9)	90.9 (28.7)
Average among students in each group						
Grade 8 English language arts state assessment scores (standardized)	–0.175 (0.979)	0.111 (0.951)	–0.188 (0.958)	–0.188 (0.922)	–0.357 (0.937)	–0.332 (0.941)
Grade 8 math state assessment scores (standardized)	–0.161 (0.930)	0.159 (0.976)	–0.173 (0.899)	–0.158 (0.976)	–0.358 (0.908)	–0.350 (0.914)
Grade 9 grade point average	2.77 (0.91)	2.93 (0.92)	2.78 (0.94)	2.74 (0.89)	2.38 (1.04)	2.40 (1.04)

Note: Sample is limited to regular high schools that enroll at least one student in a CHS course. Regular high schools are designated by the Washington Office of Superintendent of Public Instruction. They exclude alternative schools, juvenile justice facilities, schools for students with special needs, and home services.
[a] Since CHS subsidies are limited to students eligible for free or reduced-price lunch in Tier 3 schools the analytic sample is likewise limited.
[b] Chronic absenteeism is defined as attending school for fewer than 162 days (or less than 90 percent of school days).
Note: Standard deviations are in parentheses.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

Using wider bandwidths can support generalizability of the findings to students in schools further from the cutoffs since larger samples are likely to include a more diverse set of students. To test whether results from the most restrictive bandwidths determined through the process described above extend to samples of students attending schools further from the cutoffs, I increase bandwidths to 14 and 15 miles from a college that offers Running Start in Tier 1 analyses, to 100 and 150 students enrolled for Tier 2 analyses, and to 10 and 15 percent of students eligible for free or reduced-price lunch for Tier 3 analyses. Sample sizes are reported alongside results for each model. Table 5.3 presents the number of students and schools included in each of these samples.

Table 5.3. Sample sizes for alternative bandwidths in regression discontinuity models

Eligibility tier	Alternative Bandwidth	Sample	Students	Schools
1	14	Eligible	8,995	20
		Ineligible	59,271	47
	15	Eligible	8,995	20
		Ineligible	87,582	60
2	100	Eligible	4,045	16
		Ineligible	2,859	9
	150	Eligible	5,038	22
		Ineligible	4,443	12
3	10	Eligible	22,461	21
		Ineligible	19,882	34
	15	Eligible	32,907	28
		Ineligible	31,155	50

Note: Sample is limited to regular high schools that enroll at least one student in a CHS course. Regular high schools are designated by the Washington Office of Superintendent of Public Instruction. They exclude alternative schools, juvenile justice facilities, schools for students with special needs, and home services. Unique students are represented in this sample while regression analyses use data that are unique by student and school year, resulting in a larger number of observations and school clusters due to students and schools that are represented in multiple school years.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

5.2 Results

After presenting descriptive findings for all tiers, this section presents the findings of the RD analysis for each eligibility tier separately. For Tiers 1 and 2, I find that the probability of receiving subsidies among eligible schools is strong. It is weaker for Tier 3, as expected from the lower probability of being awarded subsidies near the cutoff shown in figure 5.4. Generally, I find positive relationships between eligibility for CHS subsidies and CHS course-taking outcomes for schools near the cutoffs in Tier 1 and Tier 2, but most treatment effects were small and not statistically significant. Students eligible for free or reduced-price lunch in schools near the Tier 3 cutoff did not see an impact of receiving CHS subsidies on CHS course-taking outcomes. Tier 3 results were mixed with some small positive and negative associations and none were statistically significant. After a brief summary of descriptive analysis, specific findings for each eligibility tier are presented below.

5.2.1 College in the High School Outcomes Among Students in Schools Awarded Subsidies and Students in Ineligible Schools

Among regular schools[1] that offered CHS courses, participation in CHS courses was higher among students in Tier 1 schools than in Tier 2, Tier 3 and ineligible schools (table 5.4). Students in Tier 1 schools who enrolled in CHS courses also earned more CHS credits, on average, than students who enrolled in CHS courses in Tier 2, Tier 3, and ineligible schools. This, however, may be due to unobserved characteristics about these schools and the students they serve. The RD analysis aims to reduce influences of nonrandom sorting across schools to improve understanding of the effect of the subsidies for students in treated schools near the cutoffs.

Table 5.4. Participation and credits earned in College in the High School (CHS) courses, by eligibility tier and school year among schools awarded subsidies and ineligible schools, 2016/17–2017/18

Tier in which awarded subsidies	School year	Percentage of students participating in CHS courses	Average number of CHS credits earned	
			All students	Students who enrolled in CHS courses
Awarded in Tier 1				
(N=10,877)	2016/17	21.2	0.6	2.9
(N=11,124)	2017/18	22.6	0.7	3.0
Awarded in Tier 2				
(N=2,967)	2016/17	13.7	0.3	2.0
(N=2,697)	2017/18	21.8	0.5	2.3
Awarded in Tier 3				
(N=27,240)	2016/17	10.2	0.2	2.1
(N=37,777)	2017/18	12.6	0.2	1.9
Ineligible and not awarded subsidies				
(N=160,995)	2016/17	14.4	0.3	2.2
(N=175,601)	2017/18	19.3	0.4	2.1

Note: Sample is limited to regular high schools that enroll at least one student in a CHS course. Regular high schools are designated by the Washington Office of Superintendent of Public Instruction. They exclude alternative schools, juvenile justice facilities, schools for students with special needs, and home services.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

[1] Regular high schools are designated by the Washington Office of Superintendent of Public Instruction. They exclude alternative schools, juvenile justice facilities, schools for students with special needs, and home services.

In the next three sections, I present results of the RD analysis for students attending schools in each eligibility tier. First, the relationship between the forcing variable and CHS outcomes illustrates whether a discontinuity in outcomes is apparent near the cutoff of the forcing variable. Then, I present estimates from the RD models, beginning with the first stage of the 2SLS model, and followed by a table that includes second stage results from the 2SLS estimation together with ITT estimates. Finally, to strengthen the validity of the results, I confirm that there are no discontinuities near the cutoff in pretreatment characteristics.

5.2.2 Distant Schools: Relationship Between Tier 1 Eligibility and College in the High School Course-taking Outcomes

When inspected visually, fitted lines detect a slight discontinuity in the probability of earning CHS credits near the Tier 1 cutoff (figure 5.5). Nevertheless, the probability of earning CHS credit varied substantially among schools eligible for Tier 1. This dispersion makes detecting any effects of CHS subsidies unlikely.

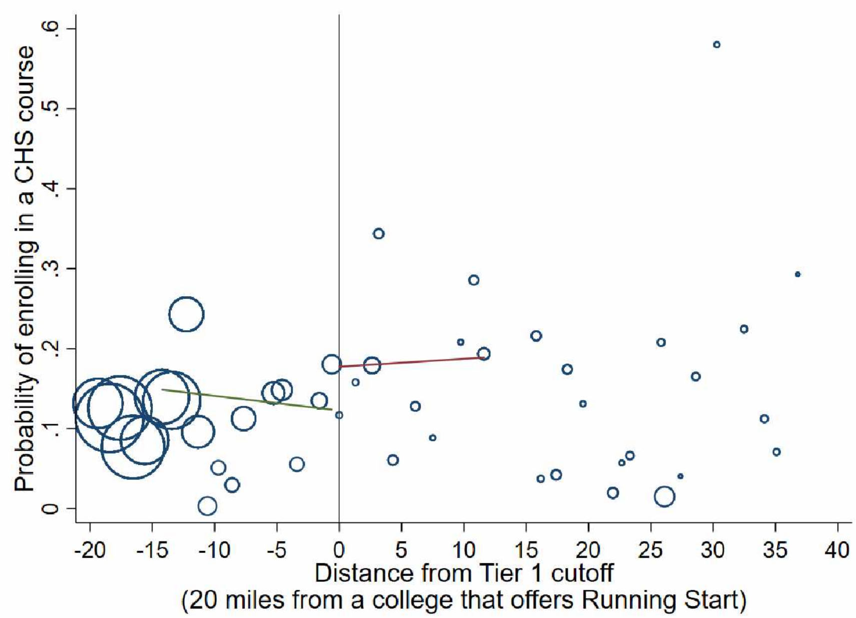

Figure 5.5. Relationship between eligibility for Tier 1 and the probability of enrolling in a College in the High School (CHS) course, 2016/17–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

In addition, discontinuities were unapparent for other outcomes (figure 5.6). These included the probability of enrolling in a CHS course in any year in high school, the number of CHS credits earned in the subsidized year, and the number of CHS credits earned throughout high school. In each case, the diffuse pattern in outcomes across different levels of the forcing variable, miles to a college that offers Running Start, is evident. These results underline the unlikelihood of detecting early impacts of HB 1546 for schools eligible for Tier 1.

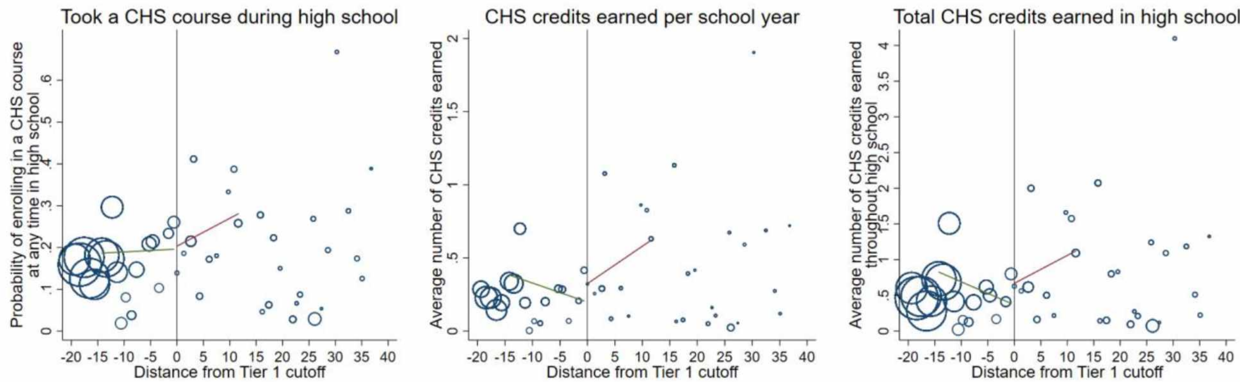

Figure 5.6. Relationship between eligibility for Tier 1 subsidies and College in the High School (CHS) course-taking outcomes, 2016/17–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

5.2.2.1 Estimates of the Effect of Eligibility for Tier 1 College in the High School Subsidies

First stage regression results find that eligibility for Tier 1 is highly predictive of receiving CHS subsidies (table 5.5). This is true across all bandwidths and model specifications. This indicates that schools who are eligible for Tier 1 subsidies are highly likely to be awarded subsidies. Because the predicted values are close to one, 2SLS estimates should be consistent with the ITT estimates.

Table 5.5. First stage results: Relationship between eligibility for Tier 1 and receipt of College in the High School subsidies, 2016/17–2017/18

	Bandwidth around cutoff of 20 miles from a college that offers Running Start					
Outcome	13 miles		14 miles		15 miles	
Awarded subsidies	0.721***	0.813**	0.738***	0.812**	0.748***	0.812**
	(0.143)	(0.243)	(0.134)	(0.241)	(0.130)	(0.241)
Covariates	X	X	X	X	X	X
Interactions, and squared distance to cutoff		X		X		X
Observations	55,484		96,286		136,264	
School clusters	55		76		89	

Note: Each cell represents a separate linear student-level specification. Covariates included school year, gender, race/ethnicity, English learner status (current or former, relative to never), indicators for whether student *i* was ever eligible for special education or migrant student services, whether student *i* was ever eligible for free or reduced-price lunch, grade 8 English language arts and math state assessment scores, standardized to have a mean of 0 and a standard deviation of 1 within school year, grade level, and test type, grade 9 grade point average, whether student *i* had ever been suspended or expelled before grade 10, and whether student *i* attended a single school in grade 9 (a measure of mobility). Interaction terms include an interaction between eligibility for Tier 1 subsidies and miles to a college that offers Running Start, and an interaction among eligibility for Tier 1 subsidies, miles to a college that offers Running Start, and the square of the miles to a college that offers Running Start.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

In second stage 2SLS and ITT results, eligibility for Tier 1 CHS subsidies tended to have positive relationships with the probability of taking a CHS course and the number of CHS credits earned (table 5.6). As expected from the first stage results (see table 5.5), the 2SLS and ITT models yield comparable estimates of this positive relationship. However, none of the findings were statistically significant. This suggests that the subsidies may have a positive influence on CHS course-taking, but it is not yet possible to rule out the possibility that the results occurred by chance. This conclusion is expected given the dispersion of outcomes by miles from a college that offers Running Start (see figure 5.5). While on balance the mean outcome is higher, a clear pattern has yet to take hold.

Table 5.6. Second stage results: Relationship between predicted propensity to receive Tier 1 College in the High School (CHS) subsidies and CHS course enrollment, 2016/17–2017/18

		Bandwidth around cutoff of 20 miles from a college that offers Running Start					
Outcome	**Model**	**13 miles**		**14 miles**		**15 miles**	
Took a CHS course in subsidized school year (odds ratios)	2SLS	2.384 (1.222)	1.726 (1.133)	1.628 (0.727)	1.761 (1.050)	1.512 (0.645)	1.410 (0.750)
	ITT	2.729 (1.616)	2.405 (2.059)	1.831 (0.938)	2.806 (2.396)	1.745 (0.876)	2.354 (1.929)
Took a CHS course at any point in high school (odds ratios)	2SLS	1.752 (0.928)	1.228 (0.766)	1.190 (0.527)	2.145 (2.547)	1.194 (0.504)	1.024 (0.509)
	ITT	1.907 (1.155)	1.466 (1.225)	1.260 (0.636)	1.106 (1.144)	1.308 (0.653)	1.351 (1.071)
CHS credits earned in subsidized school year	2SLS	0.410 (0.292)	0.101 (0.227)	0.253 (0.201)	0.101 (0.200)	0.199 (0.193)	0.0498 (0.167)
	ITT	0.463 (0.328)	0.175 (0.314)	0.304 (0.233)	0.223 (0.321)	0.258 (0.227)	0.184 (0.300)
CHS credits earned throughout high school	2SLS	0.911 (0.623)	0.276 (0.482)	0.524 (0.408)	0.252 (0.426)	0.389 (0.393)	0.132 (0.351)
	ITT	1.045 (0.706)	0.522 (0.668)	0.650 (0.475)	0.615 (0.680)	0.525 (0.463)	0.515 (0.627)
Covariates		X	X	X	X	X	X
Interactions, and squared distance to cutoff			X		X		X
Observations		55,484		96,286		136,264	
School clusters		55		76		89	

Note: Each cell represents a separate student-level specification. Logistic models are employed for binary outcomes (took a CHS course), which are reported in odds ratios. Linear specifications model CHS credits earned outcomes. Covariates included school year gender, race/ethnicity, English learner status (current or former, relative to never), indicators for whether student *i* was ever eligible for special education or migrant student services, whether student *i* was ever eligible for free or reduced-price lunch, grade 8 English language arts and math state assessment scores, standardized to have a mean of 0 and a standard deviation of 1 within school year, grade level, and test type, grade 9 grade point average, whether student *i* had ever been suspended or expelled before grade 10, and whether student *i* attended a single school in grade 9 (a measure of mobility). Interaction terms include an interaction between eligibility for Tier 1 subsidies and miles to a college that offers Running Start, and an interaction among eligibility for Tier 1 subsidies, miles to a college that offers Running Start, and the square of the miles to a college that offers Running Start.

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

5.2.2.2 Verification of Random Sorting Across the Tier 1 Cutoff

To attribute discontinuities in CHS course-taking outcomes at the cutoff to eligibility for CHS subsidies, it is necessary to show that students are randomly sorted around the cutoff. There should be no evidence of sharp changes in pretreatment characteristics and other student characteristics that are unrelated to the outcome. Upon plotting several demographic characteristics against the forcing variable, no discontinuities were observed (figure 5.7).

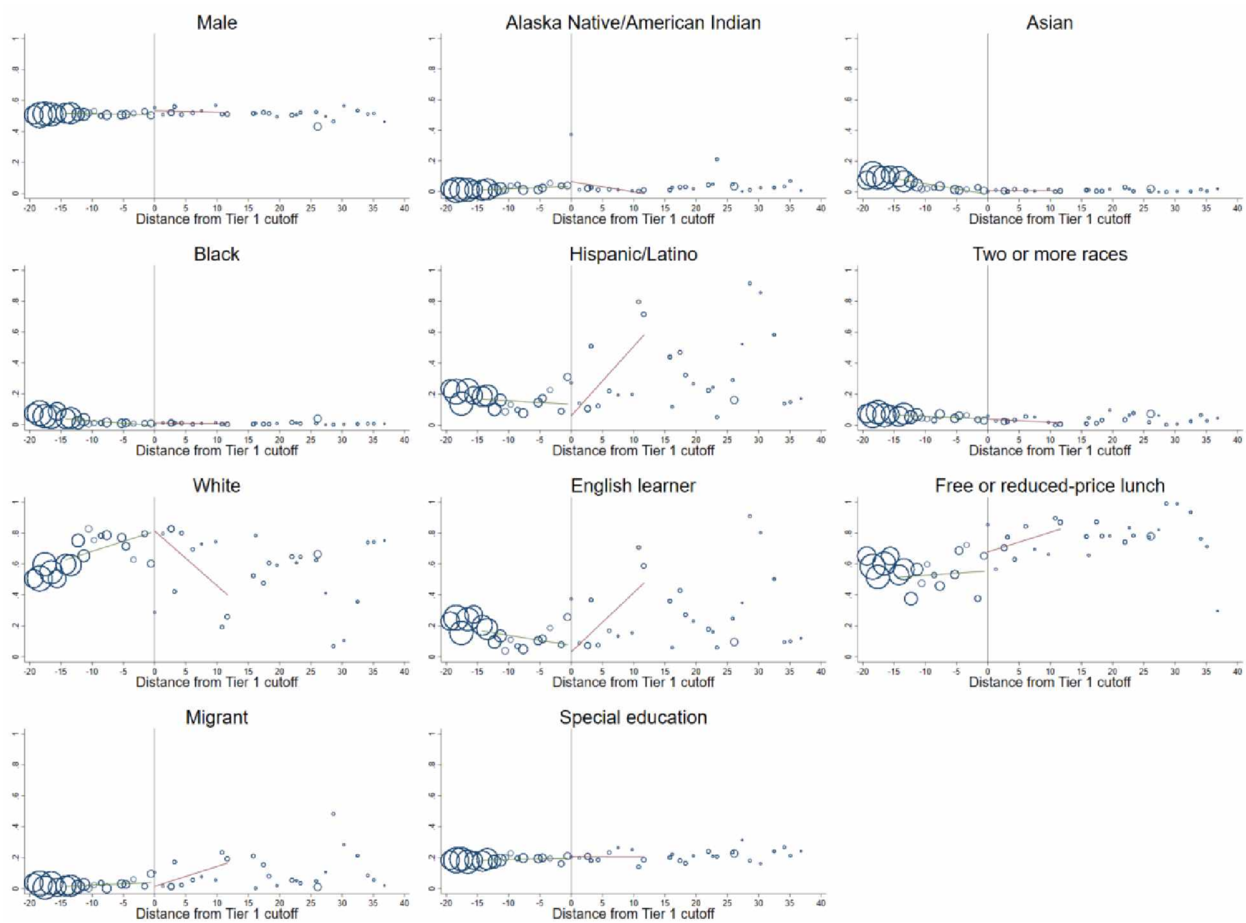

Figure 5.7. Relationship between eligibility for Tier 1 and student demographic and program enrollment characteristics, 2016/17–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

Measures of pretreatment academic achievement were also plotted against the forcing variable (figure 5.8). While fitted lines seem to show discontinuities in grade 8 standardized test scores and grade 9 grade point average, this is clearly driven by an outlier at the cutoff. In sum, although no statistically significant treatment effects were found, neither was there evidence of manipulation of the sorting process across the cutoff.

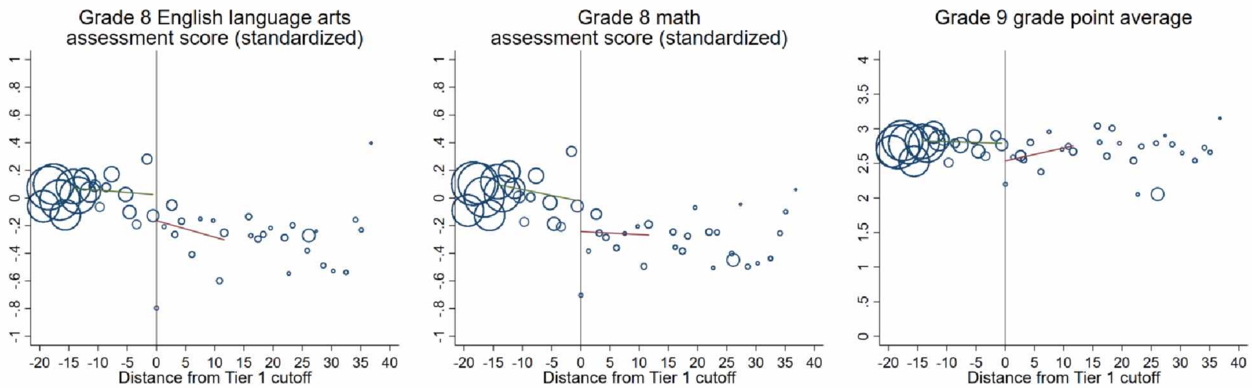

Figure 5.8. Relationship between eligibility for Tier 1 and student pretreatment academic characteristics, 2016/17–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

In addition to displaying a lack of discontinuity in pretreatment characteristics across the cutoff, figures 5.7 and 5.8 describe trends that expose potential barriers to accelerated learning option course-taking beyond being located far from a college that offers Running Start. For example, distance from a college that offers Running Start is associated with higher percentages of English learners and migrant students, ostensibly because rural areas host agrarian economies that depend on a migrant workforce. Distance from a college that offers Running Start also has a positive association with eligibility for free or reduced-price lunch and a negative relationship with grade 8 assessment scores. This means that students in Tier 1 eligible schools are, on average, less academically prepared for advanced coursework than students in ineligible schools and may face additional barriers to participation in accelerated learning option courses as a result of the complications of living in poverty and not having full command of academic English.

5.2.3 Small Schools: Relationship Between Tier 2 Eligibility and College in the High School Course-taking Outcomes

In general, the probability of earning CHS credits is low among schools with fewer than 400 students and varies widely among schools with more than 400 students (figure 5.9). There is a slight discontinuity around the Tier 2 cutoff of 300 students, where students in schools just below the cutoff (and therefore just eligible for Tier 2 subsidies) have a higher probability of earning CHS credits than students in schools just above the cutoff. There is, however, noise in this relationship and sample sizes in these schools are, by nature of the forcing variable, small. Therefore, effects must be large to be detectable.

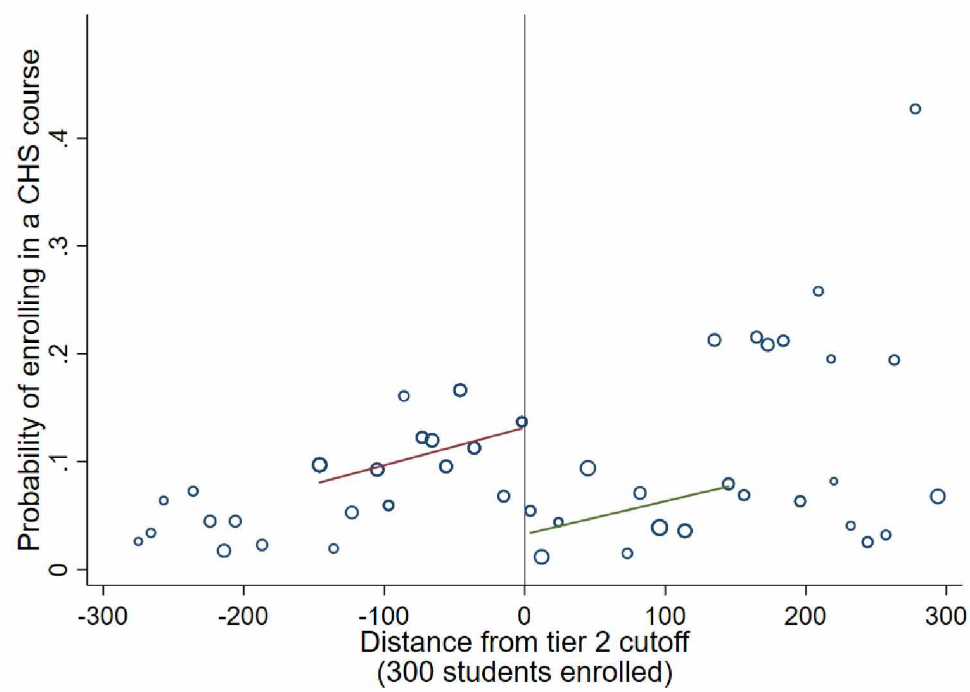

Figure 5.9. Relationship between eligibility for Tier 2 and the probability of enrolling in a College in the High School (CHS) course, 2016/17–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

Similar discontinuities appear near the forcing variable's cutoff for other CHS course-taking outcomes (figure 5.10). Likewise, the distribution of results on either side of the cutoff reflects that of the probability of enrolling in a CHS course found in figure 5.9.

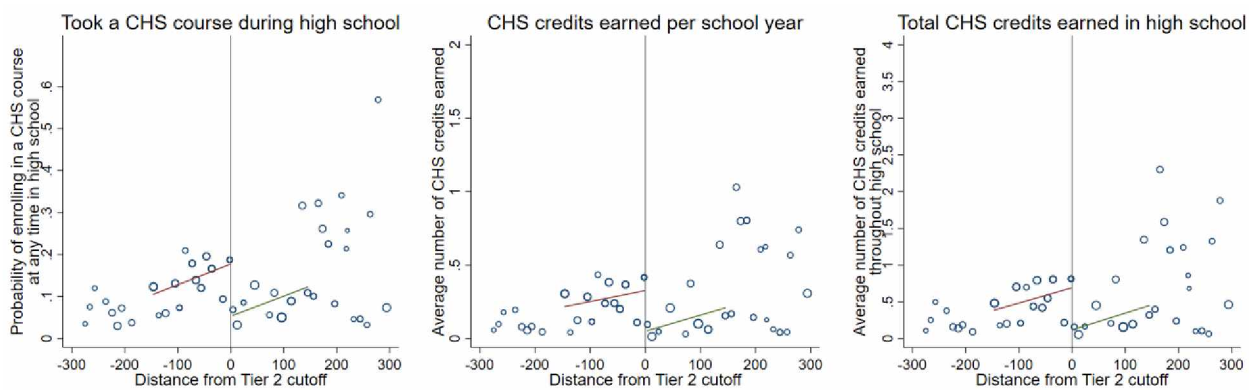

Figure 5.10. Relationship between eligibility for Tier 2 subsidies and College in the High School (CHS) course-taking outcomes, 2016/17–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

5.2.3.1 Estimates of the Effect of Eligibility for Tier 2 College in the High School Subsidies

Similar to the first stage results seen among Tier 1 schools, eligibility for Tier 2 subsidies was strongly predictive of receiving subsidies (table 5.7). Probabilities over 1 are due to estimation using a linear model, as recommended by Jacob, Zhu, Somers, & Bloom (2012). The high probabilities of CHS subsidy receipt based on eligibility should again imply that 2SLS and ITT estimates will be comparable.

Table 5.7. First stage results: Relationship between eligibility for Tier 2 and receipt of College in the High School subsidies, 2016/17–2017/18

	Bandwidth around cutoff of 300 students enrolled in regular schools					
Outcome	65		100		150	
Awarded subsidies	0.968***	0.963***	1.016***	0.946***	0.863***	1.131***
	(0.130)	(0.096)	(0.182)	(0.103)	(0.188)	(0.122)
Covariates,	X	X	X	X	X	X
Interactions, and squared distance to cutoff		X		X		X
Observations	5,891		10,050		14,715	
School clusters	18		30		42	

Note: Each cell represents a separate linear student-level specification. Covariates included school year, gender, race/ethnicity, English learner status (current or former, relative to never), indicators for whether student *i* was ever eligible for special education or migrant student services, whether student *i* was ever eligible for free or reduced-price lunch, grade 8 English language arts and math state assessment scores, standardized to have a mean of 0 and a standard deviation of 1 within school year, grade level, and test type, grade 9 grade point average, whether student *i* had ever been suspended or expelled before grade 10, and whether student *i* attended a single school in grade 9 (a measure of mobility). Interaction terms include an interaction between eligibility for Tier 2 subsidies and student enrollment, and an interaction among eligibility for Tier 2 subsidies, student enrollment, and the square of student enrollment.
Source: Author’s analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

In general, second stage results show that Tier 2 eligibility for CHS subsidies had no or weak relationships with CHS course enrollment and credit accrual (table 5.8). The basic model without interactions and square terms typically showed no relationship between eligibility for Tier 2 subsidies and CHS course-taking outcomes, with the exception of a positive, statistically significant relationship with CHS credits earned throughout high school for the 100-student bandwidth: students in schools below the cutoff earned 0.819 CHS credits more in high school than peers in schools above the cutoff, according to the 2SLS model. Quadratic models fit the data better in complete case analysis (i.e., using listwise deletion rather than multiple imputation to address missing values), as measured by a lower AIC and a higher R^2 modeled on data that was not multiply imputed (not shown). Results from specifications with squared terms and interactions have no significant relationships with CHS course-taking outcomes within the 65-student bandwidth, but 2SLS models show statistically significant positive relationships with

CHS course-taking outcomes throughout high school within the 100- and 150-student bandwidths. In particular, students in eligible schools have almost twice the odds of enrolling in a CHS course relative to the odds of students in ineligible schools and earn almost one credit more in CHS courses than students in ineligible schools below the cutoff. These results remain positive in ITT models but are not statistically significant.

Table 5.8. Second stage results: Relationship between predicted propensity to receive Tier 2 College in the High School (CHS) subsidies and CHS course enrollment, 2016/17–2017/18

		Bandwidth around cutoff of 300 students enrolled in regular schools					
Outcome	**Model**	**65**		**100**		**150**	
Took a CHS course in subsidized school year	2SLS	0.994 (0.684)	1.083 (0.747)	1.464 (0.609)	1.268 (0.530)	1.487 (0.663)	1.616 (0.623)
	ITT	1.753 (1.292)	4.828 (5.678)	1.953 (1.213)	3.326 (2.674	1.745 (1.086)	2.391 (1.559)
Took a CHS course at any point in high school	2SLS	1.110 (0.602)	1.083 (0.747)	1.855 (0.605)	1.864* (0.582)	1.621 (0.585)	1.878* (0.556)
	ITT	1.869 (1.139)	3.818 (4.003)	1.824 (0.980)	3.689 (2.635)	1.569 (0.843)	2.206 (1.180)
CHS credits earned in subsidized school year	2SLS	0.216 (0.258)	0.193 (0.208)	0.138 (0.173)	0.184 (0.196)	0.061 (0.156)	0.193 (0.137)
	ITT	0.370 (0.302)	0.527 (0.345)	0.239 (0.258)	0.582 (0.335)	0.065 (0.242)	0.288 (0.243)
CHS credits earned throughout high school	2SLS	0.444 (0.463)	0.396 (0.396)	0.819* (0.315)	0.962* (0.399)	0.508 (0.346)	0.802* (0.366)
	ITT	0.703 (0.530)	1.041 (0.699)	0.508 (0.458)	1.118 (0.609)	0.107 (0.476)	0.505 (0.447)
Covariates		X	X	X	X	X	X
Interactions, and squared distance to cutoff			X		X		X
Observations		5,891		10,050		14,715	
School clusters		18		30		42	

a The RD design is sharp at the 65 student bandwidth and therefore 2SLS estimates are equal to ITT estimates.
Note: Each cell represents a separate student-level specification. Logistic models are employed for binary models (took CHS), which are reported in odds ratios. Linear specifications model CHS credits earned outcomes. Covariates included school year, gender, race/ethnicity, English learner status (current, former, or never), indicators for whether student *i* was ever eligible for special education or migrant student services, whether student *i* was ever eligible for free or reduced-price lunch, grade 8 English language arts and math state assessment scores, standardized to have a mean of 0 and a standard deviation of 1 within school year, grade level, and test type, grade 9 grade point average, whether student *i* had ever been suspended or expelled before grade 10, and whether student *i* attended a single school in grade 9 (a measure of mobility). Interaction terms include an interaction between eligibility for Tier 2 subsidies and student enrollment, and an interaction among eligibility for Tier 2 subsidies, student enrollment, and the square of student enrollment.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

5.2.3.2 Verification of Random Sorting Across the Tier 2 Cutoff

Similar to Tier 1 results, there was no evidence of sharp changes in pretreatment characteristics and other student characteristics that are unrelated to the outcomes (figures 5.11 and 5.12). This evidence supports the assumption of random sorting across the cutoff and the validity of above results. At the same time, it is worth noting certain relationships between student characteristics and the forcing variable. Specifically, as student enrollment increases, the percentage of students eligible for free or reduced-price lunch decreases (see figure 5.11). Grade 8 assessment scores and grade 9 grade point average also have a strong relationship with school enrollment (see figure 5.12). On average, as enrollment size increases, so do test scores and grade point averages. This implies that small schools, like distant schools, may have additional barriers to offering and enrolling students in CHS courses beyond limited financial or human capacity that HB 1546 is not designed to address.

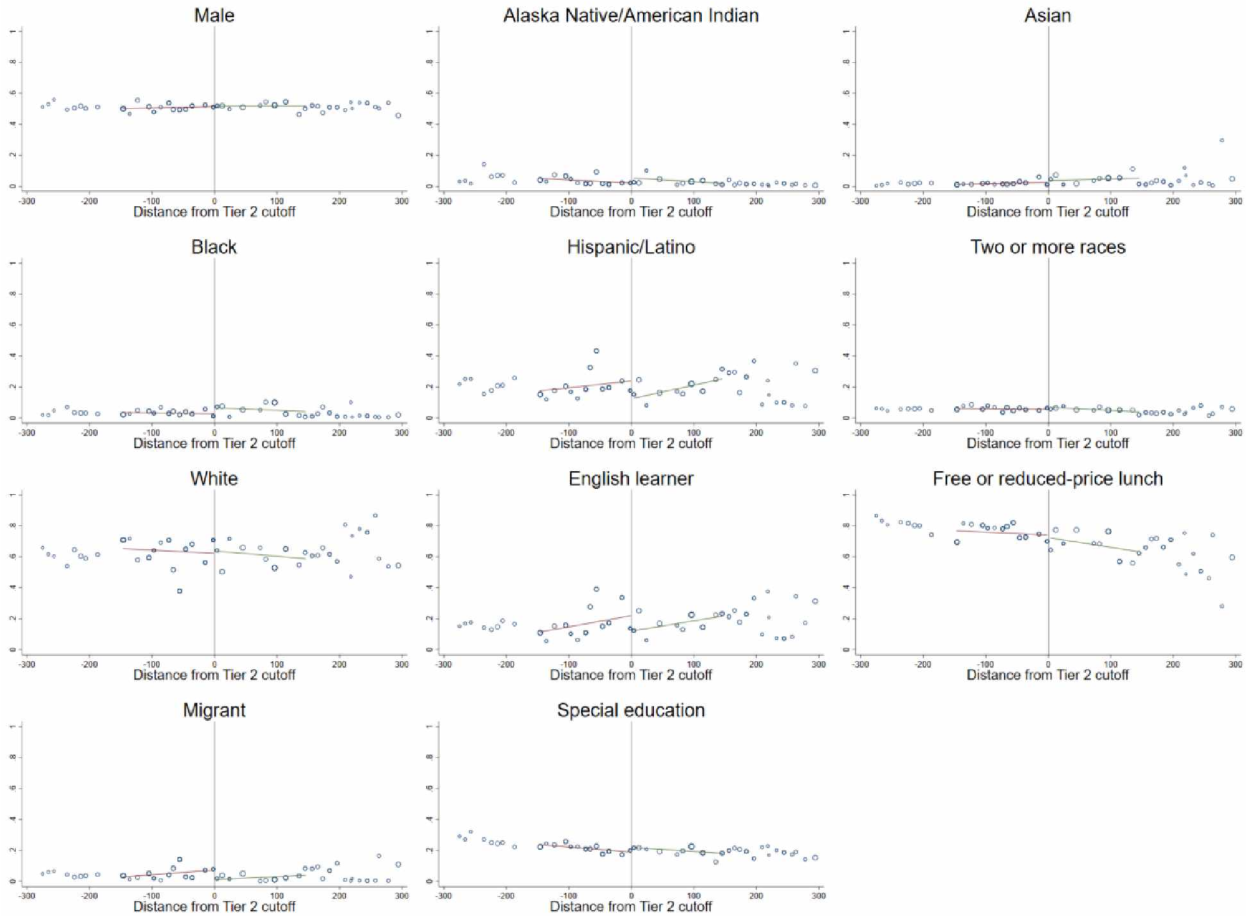

Figure 5.11. Relationship between eligibility for Tier 2 and student demographic and program enrollment characteristics, 2016/17–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

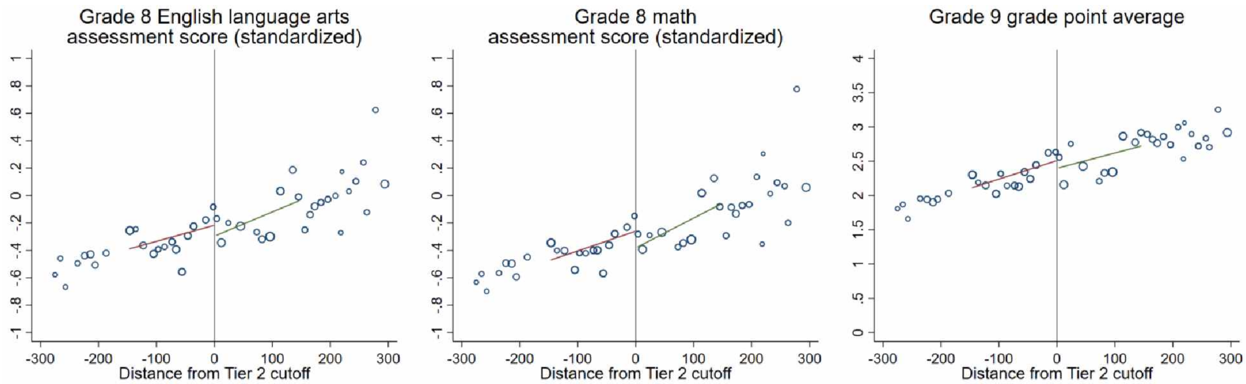

Figure 5.12. Relationship between eligibility for Tier 2 and student pretreatment academic characteristics, 2016/17–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

5.2.4 High-poverty Schools: Relationship Between Tier 2 Eligibility and College in the High School Course-taking Outcomes

Note that the relationship between eligibility for Tier 3 and the probability of earning CHS credits is polynomial around the cutoff (figure 5.13). Modeled as such, a discontinuity between eligibility status and the outcome is not evident. This is not surprising given the lower probability of schools near the cutoff to apply for subsidies. Modeled as a linear relationship, a discontinuity is apparent, though it does not fit the data well.

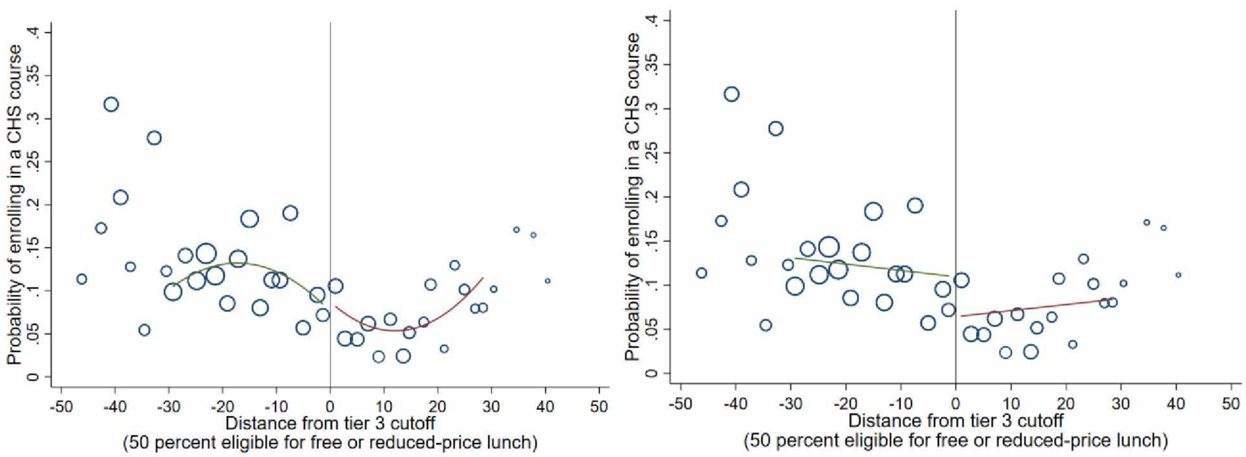

Figure 5.13. Relationship between eligibility for Tier 3 and the probability of earning College in the High School (CHS) Credits, 2016/17–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

Discontinuities among other outcomes for schools near the Tier 3 eligibility cutoff are similarly not evident with quadratic specifications and linear specifications fail to fit the data well (figure 5.14). Visual inspection of the data suggests that 2SLS and ITT models will not detect impacts for eligible schools.

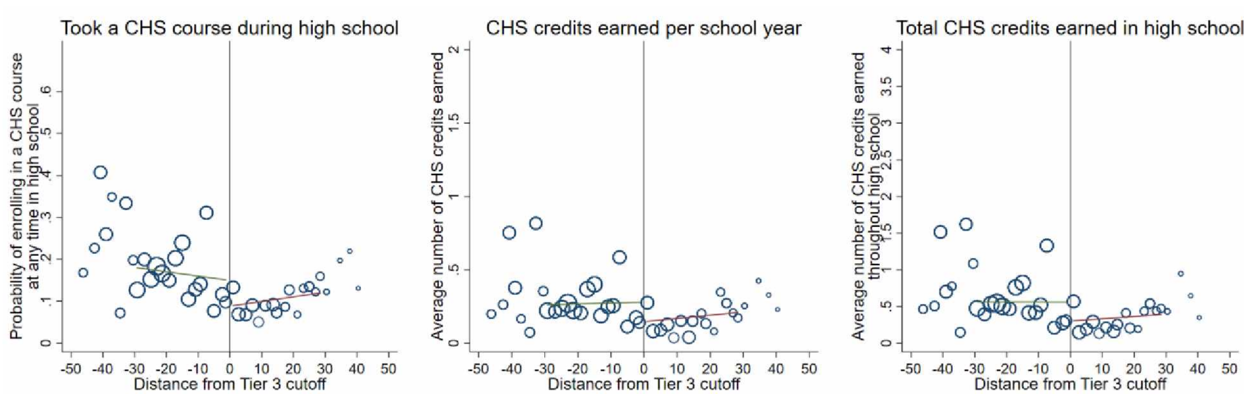

Figure 5.14. Relationship between eligibility for Tier 3 subsidies and College in the High School (CHS) course-taking outcomes, 2016/17–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

5.2.4.1 Estimates of the Effect of Eligibility for Tier 3 College in the High School Subsidies

As shown in figure 5.4, the probability of being awarded subsidies is lower around the 50 percent eligible for free or reduced-price lunch cutoff than it is further away from the cutoff. First stage regression results confirm that the probability of receiving CHS subsidies near the cutoff is not as high as it was for schools eligible in Tier 1 or Tier 2 (table 5.9). The coefficients on the 6-percentage point bandwidth are not statistically significant. This implies that 2SLS results should differ from ITT results.

Nevertheless, the probability of receipt of CHS subsidies among Tier 3 eligible schools may still be considered a valid instrument to replace eligibility for subsidies in the second stage of the 2SLS estimation. According to a weak identification test, the Cragg-Donald Wald F statistic developed by Stock and Yogo (2005), the hypothesis that the probability of receiving CHS subsidies is a weak identifier of eligibility for Tier 3 subsidies is rejected ($F = 2{,}561.4$, $\alpha = 0.05$).

Table 5.9. First stage results: Relationship between eligibility for Tier 3 and receipt of College in the High School subsidies for students eligible for free or reduced-price lunch, 2016/17–2017/18

	Bandwidth around cutoff of 50 percent of students eligible for free or reduced-price lunch					
Outcome	6		10		15	
Awarded subsidies	0.587	0.735	0.604**	0.400	0.477*	0.521*
	(0.313)	(0.689)	(0.221)	(0.330)	(0.208)	(0.249)
Covariates	X	X	X	X	X	X
Interactions, and squared distance to cutoff		X		X		X
Observations	30,891		51,565		81,363	
School clusters	37		57		84	

Note: Each cell represents a separate student-level specification. Logistic models are employed for binary outcomes (took a CHS course), which are reported in odds ratios. Linear specifications model CHS credits earned outcomes. Covariates included school year, gender, race/ethnicity, English learner status (current or former, relative to never), indicators for whether student *i* was ever eligible for special education or migrant student services, whether student *i* was ever eligible for free or reduced-price lunch, grade 8 English language arts and math state assessment scores, standardized to have a mean of 0 and a standard deviation of 1 within school year, grade level, and test type, grade 9 grade point average, whether student *i* had ever been suspended or expelled before grade 10, and whether student *i* attended a single school in grade 9 (a measure of mobility). Interaction terms include an interaction between eligibility for Tier 3 subsidies and the percentage of students eligible for free or reduced-price lunch, and an interaction among eligibility for Tier 3 subsidies, the percentage of students eligible for free or reduced-price lunch, and the square of the percentage of students eligible for free or reduced-price lunch.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

Among schools eligible for Tier 3 CHS subsidies, second stage 2SLS and ITT results show few strong relationships with CHS course-taking outcomes (table 5.10). While some are negative and some are positive, coefficients tend to be small and lack statistical significance. For example, 2SLS results show that within 6 percentage points of the cutoff of 50 percent eligible for free or reduced-price lunch, students in eligible schools have about the same odds of taking a CHS course as students in schools between 44 and 49.9 percent eligible for free or reduced-price lunch (0.906). ITT results are consistent (1.136). These results point to nontrivial variation in the outcome among a small number of schools on either side of the cutoff (see figure 14). They also suggest that CHS course-taking outcomes for eligible students in Tier 3 schools are not impacted by the policy.

Table 5.10. Second stage results: Relationship between predicted propensity to receive Tier 3 College in the High School (CHS) subsidies and CHS course enrollment for students eligible for free or reduced-price lunch, 2016/17–2017/18

		Bandwidth around cutoff of 50 percent of students eligible for free or reduced-price lunch					
Outcome	**Model**	**6**		**10**		**15**	
Took a CHS course in subsidized school year	2SLS	0.906 (1.026)	0.846 (0.559)	1.028 (0.782)	0.696 (0.467)	0.759 (0.445)	0.751 (0.435)
	ITT	1.136 (1.998)	8.044 (18.35)	1.438 (1.571)	0.648 (0.788)	0.865 (0.657)	1.092 (1.147)
Took a CHS course at any point in high school	2SLS	1.025 (1.063)	0.980 (0.594)	1.158 (0.707)	0.948 (0.525)	0.699 (0.388)	0.873 (0.364)
	ITT	1.349 (2.273)	13.85 (29.03)	1.753 (1.632)	1.328 (1.621)	0.771 (0.567)	1.394 (1.268)
CHS credits earned in subsidized school year	2SLS	0.086 (0.160)	0.032 (0.080)	0.054 (0.121)	0.016 (0.083)	–0.042 (0.106)	–0.017 (0.075)
	ITT	0.163 (0.288)	0.244 (0.362)	0.168 (0.167)	0.202 (0.178)	0.009 (0.132)	0.120 (0.163)
CHS credits earned throughout high school	2SLS	0.268 (0.316)	0.108 (0.130)	0.187 (0.229)	0.085 (0.144)	–0.073 (0.212)	0.016 (0.132)
	ITT	0.514 (0.581)	0.913 (0.851)	0.477 (0.324)	0.533 (0.350)	0.052 (0.267)	0.383 (0.307)
Covariates		X	X	X	X	X	X
Interactions, and squared distance to cutoff			X		X		X
Observations		30,891		51,565		81,363	

Note: Each cell represents a separate student-level specification. Logistic models are used for binary outcomes (took a CHS course), which are reported in odds ratios. Linear specifications model CHS credits earned outcomes. Covariates included school year, gender, race/ethnicity, English learner status (current or former, relative to never), indicators for whether student *i* was ever eligible for special education or migrant student services, whether student *i* was ever eligible for free or reduced-price lunch, grade 8 English language arts and math state assessment scores, standardized to have a mean of 0 and a standard deviation of 1 within school year, grade level, and test type, grade 9 grade point average, whether student *i* had ever been suspended or expelled before grade 10, and whether student *i* attended a single school in grade 9 (a measure of mobility). Interaction terms include an interaction between eligibility for Tier 3 subsidies and the percentage of students eligible for free or reduced-price lunch, and an interaction among eligibility for Tier 3 subsidies, the percentage of students eligible for free or reduced-price lunch, and the square of the percentage of students eligible for free or reduced-price lunch.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

5.2.3.2 Verification of Random Sorting Across the Tier 3 Cutoff

Consistent with the above results for Tier 1 and Tier 2, there were no threats to the validity of the Tier 3 results from nonrandom student sorting at the cutoff (figures 5.15 and 5.16). While no discontinuities near the cutoff are evident, some notable relationships between the forcing variable and student characteristics emerged. High-poverty schools serve larger percentages of Hispanic/Latino students, as well as higher percentages of English learner and migrant students (see figure 5.15). Students who are not proficient in English or who experience interrupted education as part of a migrant family face unique challenges to participating in advanced coursework (Hanson, Bisht, & Greenberg Motamedi, 2016). In addition, school poverty has a strong correlation with prior achievement test scores (see figure 5.16). That is, high-poverty high schools serve students with lower academic preparation for advanced coursework and lower levels of English proficiency.

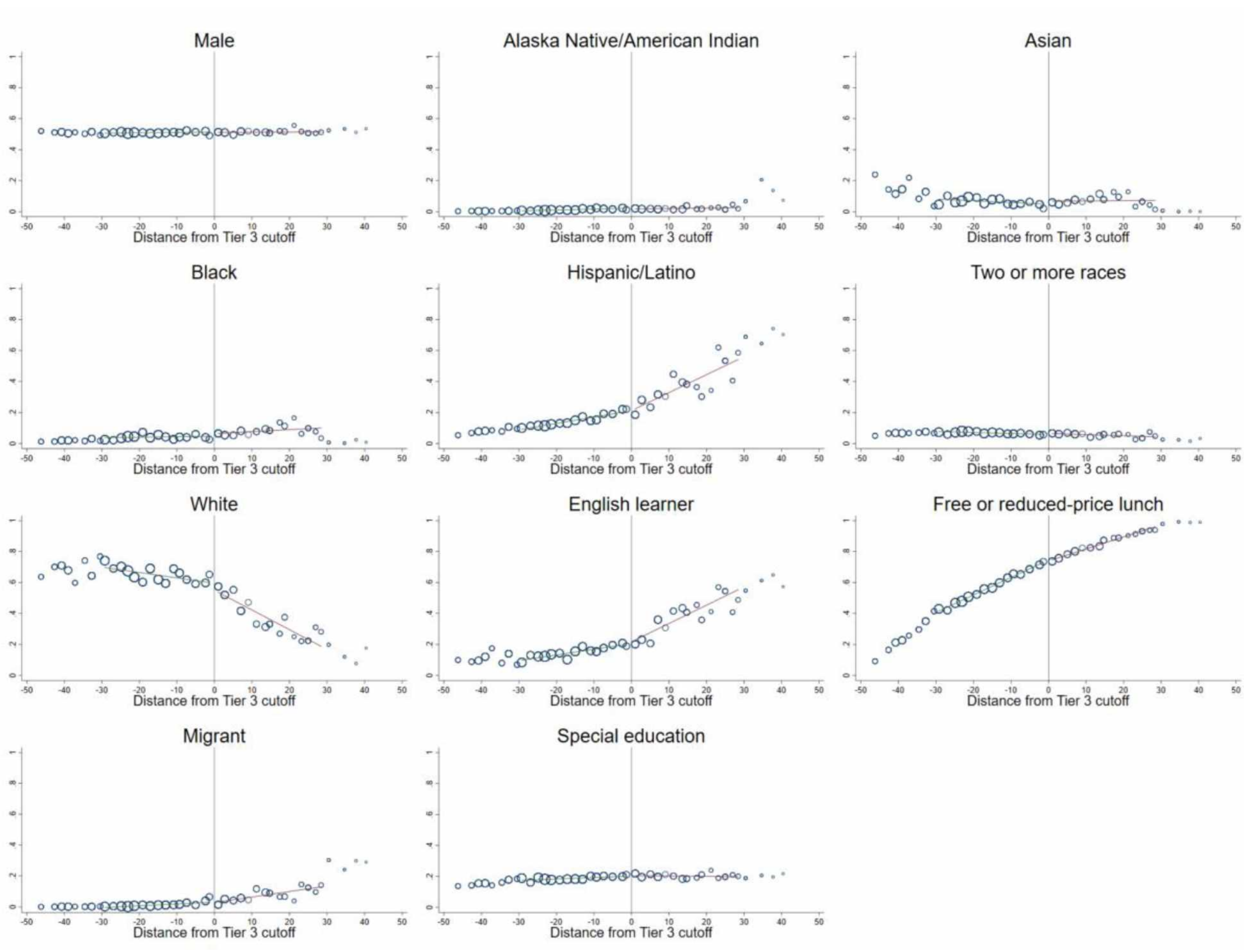

Figure 5.15. Relationship between eligibility for Tier 3 and student demographic and program enrollment characteristics, 2016/17–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

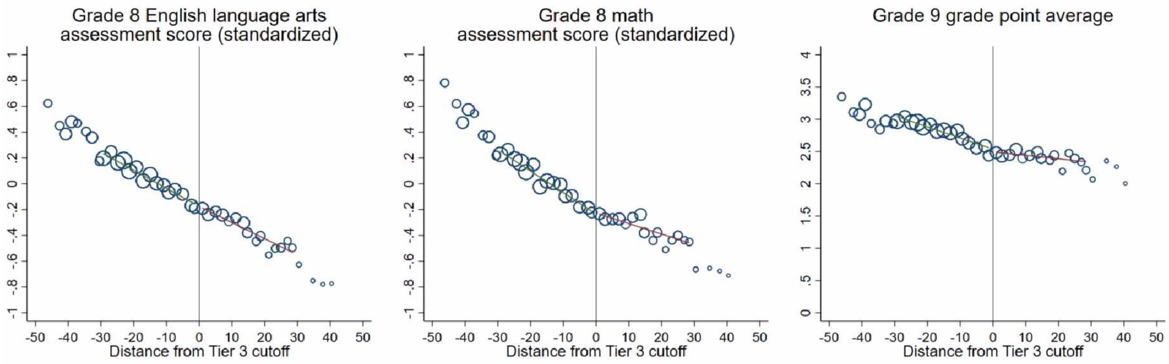

Figure 5.16. Relationship between eligibility for Tier 3 and student pretreatment academic characteristics, 2016/17–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data, 2016/17–2017/18.

5.3 Discussion

There are some positive relationships between Tier 1 and Tier 2 eligibility for CHS subsidies and CHS course-taking outcomes. This suggests that the policy may be beginning to influence an upward trend in CHS course enrollment and credit accrual for students attending schools near the eligibility cutoffs. However, these are typically small and not statistically significant. Underlying this result is wide variation in outcomes across values of the forcing variables (see figures 5.5 and 5.9). Moreover, the study found no effects for students in Tier 3 schools near the cutoff. In addition to variation in outcomes around the cutoff, these schools had a lower probability of being awarded subsidies (see figure 5.4). Thus, estimates for Tier 3 schools include a larger proportion of schools that did not receive CHS subsidies than Tier 1 and Tier 2 schools, potentially muting the policy's impact on schools that received subsidies.

More implementation data is needed to diagnose why schools eligible for Tier 1 and Tier 2 CHS subsidies experience widely varying levels of success in expanding enrollment in CHS courses. Some potential implementation barriers to CHS course enrollment in eligible schools are discussed above, such as low levels of academic preparation and English proficiency and high levels of student poverty among eligible schools. HB 1546 is not designed to equip schools with the tools or resources to overcome these barriers, but rather to remove a financial burden for acquiring college credits from CHS courses. Nevertheless, these conditions may limit the effectiveness of the policy to bring about equitable outcomes in accelerated learning option course-taking. Integrated state and local efforts to bolster preparation for advanced courses in elementary and middle school, to accelerate English proficiency, and to alleviate child poverty and its constraints on learning should be studied with respect to access to and participation in rigorous curricula in high school. In addition, further investigation into the factors that facilitate or hinder positive CHS enrollment outcomes could help generate best practices for the state to share across eligible schools and inform state efforts to achieve the policy's intended impacts.

5.4 Limitations and Areas for Future Research

This study met the assumptions needed for a valid RD design with respect to the attributes of the forcing variables, the levels of compliance with assignment to the intervention, the lack of evidence of manipulation of the assignment process, and evidence of random sorting around the cutoff. However, as discussed above, this study has a number of limitations that should be considered when interpreting the results. To recap, about 17 percent of students were missing grade 8 achievement test scores and/or grade 9 grade point average. I used multiple imputation to avoid losing this substantial sample of the data, and in doing so give up some precision for the results. Importantly, this study's generalizability is limited by the condition that schools needed to have demonstrated evidence of enrolling students in CHS courses in the past to be included in the sample. While HB 1546 might be a factor that inspires schools to develop programs, as could be suggested by table 3.2 in chapter 3, the applicability of the results for schools that developed CHS programs after the 2017/18 school year is limited.

In addition, due to the lower rates of awarding subsidies to Tier 3 schools near 50 percent eligible for free or reduced-price lunch cutoff, the RD model may not be the best way of measuring impact for students in high-poverty schools. Schools far from the cutoff with high percentages of students eligible for free or reduced-price lunch had much higher probabilities of being awarded subsidies, and likely more certainty among administrators who applied for the subsidies that the school would be eligible. Future research could apply a matching technique, such as propensity score matching or coarsened exact matching to study impacts of receiving CHS subsidies for students in high-poverty schools.

Finally, while there may be school characteristics that are difficult to observe and influence whether or not a school offers CHS courses, there are also unobservable student characteristics that influence their likelihood of participating in CHS courses. Therefore, although schools may be eligible for CHS subsidies at random right above and below the cutoffs for each tier, nonrandom student sorting is still possible within schools. The types of CHS courses schools offer may also vary, and the likelihood of students to participate in them may vary according to their interests and the prerequisites they have met. For example, calculus courses may draw a different group of students than Spanish courses. Future research could examine the extent to which variability in program offerings influences participation in them and whether patterns of variation differ by eligibility for subsidies.

6.0 Post-HB 1546 Changes in Grade 10 Dual Credit Course-taking

The previous chapter examined the impact of a primary component of HB 1546: subsidies for underrepresented students to earn dual credit from College in the High School (CHS) courses. The other main feature of HB 1546 is its extension of eligibility to earn college credit in CHS courses to students in grade 10. Although their tuition cannot be subsidized, grade 10 students in schools eligible for subsidies may benefit from increased access to programming (see table 3.2). This chapter evaluates the impact of each of these aspects of the policy. First, I assess grade 10 students' participation in CHS courses before and after the implementation of HB 1546. Second, I estimate policy effects for underrepresented groups of students, including students in schools eligible for CHS subsidies, English learners, students from different racial/ethnic groups, students eligible for free or reduced-price lunch, and students attending schools with different urbanicities. The purpose of these analyses is to elucidate differential effects of the policy, if any exist. The results tend to show positive, statistically significant impacts of the policy on grade 10 CHS course-taking outcomes and provide insight to help understand whether the policy may be having its intended effect of closing gaps in CHS course-taking.

6.1 Methods

This study comprises two series of analyses that combine a statistical matching technique with longitudinal modeling. The first set of analyses measures changes in the probability of enrolling in a CHS course as well as changes in the number of high school credits earned in CHS courses for grade 10 students before and after 2015/16—the year HB 1546 made it possible for these students to earn college credits in CHS courses. The second set of analyses compares changes over time in the probability of enrolling in a CHS course and in the number of high school credits earned in CHS courses for grade 10 students among schools that were eligible and ineligible for CHS subsidies. This measures the effect of school eligibility for CHS subsidies on grade 10 students who are not themselves allowed to use the subsidies, but who may benefit from increased program capacity.

Each analysis measures outcomes for all students and for groups of statistically paired students in treatment and control conditions. They all further analyze outcomes separately for student groups of interest for the study— each racial/ethnic group, students who have ever or never been eligible for free or reduced-price lunch, students who were formerly English learners prior to entering high school, students who were English learners during high school, and students who were never English learners, and students attending schools with different urbanicities. Sections 6.1.2.1 through 6.1.2.3 describe the sample and methodological approach for each analysis.

6.1.1 Measuring Effects of HB 1546 on Grade 10 College in the High School Course-taking with a Short Interrupted Time Series

I used a short interrupted time series (ITS) design to test whether expanding the opportunity to earn college credit in CHS courses to grade 10 students and providing funding to students in target groups through HB 1546 changed CHS enrollment and credit accrual (Bloom, 1999). The design estimates trends before the policy change to predict course-taking outcomes had the policy not been established (the counterfactual). Then, it measures the difference in actual and predicted outcomes during the post-policy years. Those deviations illustrate a pattern of the policy change's impacts over time.

I begin by producing descriptive summaries of CHS course-taking among grade 10 students over time. I include illustrations of trends over time to clarify relationships between outcomes and policy implementation. Observing a nonlinear trend in post-policy outcomes triggered two adjustments to the interrupted time series modeling strategy. First, a square term was added to the time predictor (measured in school years) for the standard model. Then, a second, "saturated" model was used to estimate treatment effects in each of the three post-policy years. Each approach includes a logistic regression model for the dichotomous outcome of whether or not student *i* enrolled in a CHS course and a linear model for the continuous outcome of the number of CHS credits earned in a school year. The standard ITS models are described as follows:

$$p(enroll = 1)_{ij} = \alpha + \beta_1 Postpolicy_{ij} + \beta_2 Year_{ij} + \beta_3 Postpolicy \times Year_{ij} + \beta_4 Year_{ij}^2 + \boldsymbol{X}_{ij} + \boldsymbol{\theta}_j \quad (6.1)$$

while the continuous model is described below:

$$Y_{ij} = \alpha + \beta_1 Postpolicy_{ij} + \beta_2 Year_{ij} + \beta_3 Postpolicy \times Year_{ij} + \beta_4 Year_{ij}^2 + \boldsymbol{X}_{ij} + \boldsymbol{\theta}_j + \varepsilon_{ij} \quad (6.2)$$

where $p(enroll = 1)$ describes the probability that student *i* enrolled in at least one CHS course at school *j*; *Yij* represents the number of CHS high school credits earned by student *i* in school *j*; *Postpolicy* is an indicator for whether the year in which student *i* was in grade 10 was after the implementation of HB 1546 (2015/16–2017/18); *Year* denotes time in school years, spanning all six baseline years (2009/10 to 2014/15) and three follow-up years (2015/16 to 2017/18), with the first policy implementation year, 2015/16, centered at 0; an interaction term between *Postpolicy* and *Year*, a squared term for *Year*, and ***X***, a set of student-level covariates including binary indicators for gender, each racial/ethnic group, whether student *i* was ever eligible for free or reduced-price lunch, whether student i was ever eligible for migrant student services, whether student i was ever eligible for special education services, whether student i was an English learner during high school, whether student i was a former English learner who reclassified as English proficient before high school, whether student i was chronically absent in grade 9, whether student i was ever suspended or expelled before grade 10, student i was suspended or expelled during grade 10, and whether student i attended a single school in grade 9 (a measure of mobility), and continuous variables for grade 9 grade point average, and grade 8 English language arts and math state assessment scores, standardized within school year and test type to have a mean of 0 and a standard deviation of 1. $\boldsymbol{\theta}$ represents a set of school-level covariates including the percentage of students eligible for free or reduced-price lunch, the number of students enrolled, and a set of indicators for each urbanicity (fringe, distant, and remote, with urban/suburban as the referent category). The error term, ε, is clustered by school and assumed to be independent and identically distributed according to a normal distribution a mean of zero and variance σ^2.

The saturated logistic model is defined as:

$$p(\text{enroll} = 1)_{ij} = \alpha + \beta_1 Year_{ij} + \beta_2 Year_{ij}^2 + \beta_3 Year1_{ij} + \beta_4 Year2_{ij} + \beta_5 Year\ 3_{ij} + \boldsymbol{X}_{ij} + \boldsymbol{\theta}_j \tag{6.3}$$

while the saturated continuous model is defined as:

$$Y_{ij} = \alpha + \beta_1 Year_{ij} + \beta_2 Year_{ij}^2 + \beta_3 Year1_{ij} + \beta_4 Year2_{ij} + \beta_5 Year\ 3_{ij} + \boldsymbol{X}_{ij} + \boldsymbol{\theta}_j + \varepsilon_{ij} \tag{6.4}$$

where $p(enroll = 1)$ describes the probability that student i enrolled in at least one CHS course at school j; Yij represents the number of CHS high school credits earned by student i in school j; *Year1*, *Year 2*, and *Year3* are binary indicators for each year of the intervention, 2015/16, 2016/17, and 2017/18, respectively, set to 1 if a student was in grade 10 in that year and 0 otherwise, and

Year, $\boldsymbol{X}$, and $\boldsymbol{\theta}$ are defined as above. The error term, ε, is clustered by school and assumed to be independent and identically distributed according to a normal distribution a mean of zero and variance σ^2.

6.1.2 Establishing Baseline Equivalence with Coarsened Exact Matching

The primary weakness of the ITS design is "history" or the case in which another, possibly unobserved, major event coincided with the policy change that can provide an alternative explanation for the observed deviations from the trend. I mitigated this risk by employing a coarsened exact matching (CEM) process to match students who were in grade 10 in 2015/16 through 2017/18 to students who were in grade 10 between 2009/10 and 2014/15 (Iacus, King & Porro, 2012). Adjusting the sample to establish baseline equivalency on observed characteristics can reduce the possibility that changes in the student population over time could be responsible for the observed trends in CHS course-taking.

As a matching strategy, CEM requires no assumptions about the data generation process beyond the usual ignorability assumptions and performs as well or better than other commonly used matching methods, such as propensity score matching, in its ability to reduce imbalance between treatment and comparison groups, model dependence, estimation error, bias, variance, and mean square error (Iacus, King & Porro, 2012).

CEM coarsens each variable through recoding so that substantively indistinguishable values are grouped and assigned the same numerical value. Then, an "exact matching" algorithm is applied to the coarsened data to determine the matches and prune unmatched units. Finally, the coarsened data are discarded and the original values of the matched data are retained for analysis. Specifically, the CEM algorithm creates a set of strata, each with the same coarsened values of $\boldsymbol{X}$

$= (X_1, X_2, \ldots, X_k)$, a k-dimensional dataset, where each X_j is a column vector of observed values of pretreatment variable j for n sample observations. Units in strata that contain at least one treated and one comparison student are retained while all other strata are removed from the sample. Each matched student, i in stratum s is assigned a weight:

$$w_i = \begin{cases} 1, & i \in T^s \\ \frac{m_C}{m_T} \cdot \frac{m_T^s}{m_C^s}, & i \in C^s \end{cases} \tag{6.5}$$

where T^s represents the treated students in stratum s, $m^s{}_T$ is the number of treated students in each stratum, and m_T is the number of matched students in the treatment group. Similarly, for comparison students, C^s, $m^s{}_C$ is the number of treated students in each stratum and m_C is the number of matched students in the treatment group (Iacus, King & Porro, 2012).

The matching algorithm includes several pretreatment characteristics that are associated with variation in enrollment in accelerated learning option courses. These include indicators for gender, race/ethnicity, eligibility for free or reduced-price lunch, eligibility for migrant student services, eligibility for English language development services, eligibility for special education services, English as a primary or home language, chronic absence in grade 9, a suspension or expulsion before grade 10, attending only one school in grade 9, grade 9 grade point average, and grade 8 English language arts and math state assessment scores, standardized within school year and test type to have a mean of 0 and a standard deviation of 1. Exact matches were required for all variables except grade 9 grade point average and grade 8 English language arts and math assessment scores. In addition, as discussed in the previous chapter, because more than 10 percent of students were missing grade 9 grade point average and/or grade 8 English language arts and math assessment scores, I used the multiply imputed datasets to conduct the matching algorithms. In other words, I produced five matched sets of data, one for each of the five imputed values assigned to records with missing data. After dividing the dataset into five files, each analysis, including checks for baseline equivalence, needed to be performed five times to obtain appropriately adjusted standard errors.

Although there were no remaining statistically significant differences between the treatment and comparison groups after matching, all matching variables were included as control variables in the models described in equations 6.1–6.4 to account for remaining variation between the treatment and comparison groups. Table 6.1 presents sample characteristics prior to and after the CEM procedure. Note that because the matching procedure was conducted using multiply imputed data, the means and standard deviations in table 6.1 represent averages among non-missing records. The differences and p-values, on the other hand, are calculated using regression commands that make accommodations for multiply imputed data to obtain more precise estimates and standard errors.

Table 6.1. Full and matched sample descriptive statistics and means comparisons for grade 10 students enrolled before and after the implementation of HB 1546, 2009/10–2017/18

	Full sample					**Matched sample**				
	Year enrolled in grade 10					**Year enrolled in grade 10**				
	2009/10–2014/15		**2015/16–2017/18**			**2009/10–2014/15**		**2015/16–2017/18**		
Characteristic	**Mean**	**SD**	**Mean**	**SD**	**Diff.[a]**	**Mean**	**SD**	**Mean**	**SD**	**Diff.[a]**
Male	50.9	50.0	51.0	50.0	0.02	49.5	50.0	49.5	50.0	0
American Indian/Alaska Native	2.4	15.2	2.5	15.6	0.08***	0.9	9.6	0.9	9.6	0
Asian	6.9	25.4	7.6	26.5	0.5***	6.6	24.8	6.6	24.8	0
Black	4.3	20.2	4.5	21.1	0.1***	2.5	15.6	2.5	15.6	0
Hispanic/Latino	18.8	39.1	20.8	40.1	2.6***	16.0	36.7	16.0	36.7	0
Two or more races	5.6	22.9	6.4	24.5	1.5***	4.9	21.5	4.9	21.5	0
White	62.1	48.5	58.3	49.3	–4.8***	69.1	46.2	69.1	46.2	0
Ever eligible for free or reduced-price lunch	56.0	49.6	60.0	49.0	7.9***	51.8	50.0	51.8	50.0	0
Ever eligible for English language development services	15.3	34.8	20.4	40.3	7.0***	13.4	34.0	13.4	34.0	0
Ever eligible for migrant student services	2.7	16.2	3.2	17.6	0.8***	1.6	12.4	1.6	12.4	0
Ever eligible for special education services	14.1	34.8	18.8	39.1	4.8***	11.4	31.8	11.4	31.8	0
English primary or home language	82.9	37.6	82.3	38.2	–2.0***	86.7	34.0	86.7	34.0	0
Chronically absent in grade 9	21.3	41.0	21.2	40.9	1.1***	15.6	36.2	15.6	36.2	0
Suspended or expelled before grade 10	3.6	18.7	6.5	24.7	4.6***	1.1	10.2	1.1	10.2	0
Attended one school in grade 9										
Grade 9 grade point average	2.68	1.02	2.75	1.02	0.04***	2.92	0.95	2.92	0.94	0.01
Grade 8 English language arts state assessment score (standardized)	0.025	0.990	0.026	0.993	–0.006**	0.178	0.878	0.182	0.881	–0.003
Grade 8 math state assessment score (standardized)	0.022	0.990	0.069	1.000	0.033***	0.221	0.893	0.215	0.895	–0.002
Observations	693,897		445,419			362,500		204,064		

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] Differences are based on estimation of multiply imputed data, as are treatment estimates. Values for means and standard deviations exclude records with missing values.

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data.

6.1.3 Measuring Effects of HB 1546 on Grade 10 Students in Schools Eligible for College in the High School Subsidies Through Comparative Interrupted Time Series

I used a similar approach to compare trends in dual credit course-taking pre- and post-HB 1546 implementation for schools that were and were not eligible for CHS subsidies. I assigned students to a treatment group if they attended a school that met the eligibility criteria for CHS subsidies and all other students to a comparison group. The design of this analysis is called comparative interrupted time series (CITS) (Shadish, Cook & Campbell, 2002). This model estimates changes associated with an event by measuring whether a treatment group (i.e., students in schools eligible to receive funding) deviated from its trend before the treatment by a greater amount than a comparison group (i.e., schools that were ineligible to receive funding). In theory, this design can reduce bias in the estimates by controlling for both the baseline mean and trends over time for both treatment and comparison groups (Jacob, Somers, Zhu, & Bloom, 2016). Additionally, the standard errors on the forecasted estimates of the outcome based on the pre-treatment trend increase for each period to account for the fact that predictions are less reliable over time. Making longer-term estimates within an increasing confidence interval can reduce the likelihood of Type I errors (rejecting the null hypothesis when it is true). While this analysis aimed only to describe patterns in relationships between the policy change and student outcomes, this design enabled comparisons over time with more conservative estimates of the standard errors.

The model for the probability that a student in an eligible school will take at least one CHS course relative to students in ineligible schools is as follows:

$$p(\text{enroll} = 1)_{ij} = \alpha + \beta_1 Eligible_{ij} + \beta_2 Postpolicy_{ij} + \beta_3 Year_{ij} + \beta_4 Eligible \times Year_{ij} + \beta_5 Eligible \times Postpolicy_{ij} + \beta_6 Postpolicy \times Year_{ij} + \beta_7 Eligible \times Postpolicy \times Year_{ij} + \beta_8 Year_{ij}^2 + \boldsymbol{X}_{ij} + \boldsymbol{\theta}_j \quad (6.6)$$

while the continuous model for the number of CHS credits earned is described as:

$$Y_{ij} = \alpha + \beta_1 Eligible_{ij} + \beta_2 Postpolicy_{ij} + \beta_3 Year_{ij} + \beta_4 Eligible \times Year_{ij} + \beta_5 Eligible \times Postpolicy_{ij} + \beta_6 Postpolicy \times Year_{ij} + \beta_7 Eligible \times Postpolicy \times Year_{ij} + \beta_8 Year_{ij}^2 + \boldsymbol{X}_{ij} + \boldsymbol{\theta}_j + \varepsilon_{ij} \quad (6.7)$$

where *p*(*enroll* = 1) describes whether student *i* enrolled in CHS at school *j*; *Yij* represents the number of CHS high school credits earned by student *i* in school *j*; *Eligible* is a treatment indicator set to 1 if a student attended a school that met the criteria for CHS subsidies and 0 otherwise; *Postpolicy* is an indicator for whether the year in which student *i* was in grade 10 was after the implementation of HB 1546 (2015/16–2017/18); *Year* denotes time in school years, spanning all six baseline years (2009/10 to 2014/15) and three follow-up years (2015/16 to 2017/18), with the first policy implementation year, 2015/16, centered at 0. Testing for differences between eligible and ineligible schools requires including all two- and three-way interactions (Wong, Cook, & Steiner, 2015). The regression coefficient for β_5 of the *Eligible* × *Postpolicy* interaction yields the differences in the mean change in outcomes after 2015/16. The three-way interaction effect *Eligible* × *Postpolicy* × *Year* tests whether eligible and ineligible schools differ in their post-HB 1546 slope changes. The error term, ε, is clustered by school and assumed to be independent and identically distributed according to a normal distribution a mean of zero and variance σ^2.

Once again, the CITS approach is paired with CEM to establish baseline equivalency between students in eligible and ineligible schools on baseline characteristics. Baseline characteristics for the full and matched samples of students in eligible and ineligible schools are reported in table 6.2. Results from the CITS analyses are shown for the full and matched samples in table 6.5.

Table 6.2. Full and matched sample descriptive statistics and means comparisons for grade 10 students enrolled before and after the implementation of HB 1546, 2009/10–2017/18

	Full sample					**Matched sample**				
	Eligibility for CHS subsidies					**Eligibility for CHS subsidies**				
	Ineligible		**Eligible**			**Ineligible**		**Eligible**		
Characteristic	**Mean**	**SD**	**Mean**	**SD**	**Diff.**	**Mean**	**SD**	**Mean**	**SD**	**Diff.**
School year	2014.1	2.58	2014.1	2.58	–0.0004	2014.1	2.57	2014.1	2.57	0
Male	51.1	50.0	51.6	50.0	0.004**	50.9	50.0	50.9	50.0	0
American Indian/Alaska Native	2.4	15.4	2.8	16.6	0.004***	1.6	12.5	1.6	12.5	0
Asian	8.8	28.3	4.1	19.8	–0.046***	3.5	18.4	3.5	18.4	0
Black	5.0	21.8	4.1	19.9	–0.009***	3.2	17.7	3.2	17.7	0
Hispanic/Latino	14.9	35.6	30.7	46.1	0.158***	26.3	44.0	26.3	44.0	0
Two or more races	6.3	24.3	4.0	19.5	–0.023***	3.4	18.1	3.4	18.1	0
White	62.6	48.4	54.3	49.8	–0.083***	62.0	48.5	62.0	48.5	0
Ever eligible for free or reduced-price lunch	50.5	50.0	68.9	46.3	0.184***	65.1	47.7	65.1	47.7 39.9	0
Ever eligible for English language development services	13.6	34.3	24.6	46.1	0.110***	19.8	39.9	19.8	47.7	0
Ever eligible for migrant student services	1.2	10.8	6.8	25.1	0.056***	3.5	18.5	3.5	18.5	0
Ever eligible for special education services	15.5	35.7	15.9	36.5	0.008***	12.3	32.9	12.3	32.9	0
English primary or home language	85.1	35.6	74.6	43.5	–0.105***	79.2	40.6	79.2	40.6	0
Chronically absent in grade 9	22.8	41.9	24.2	42.8	0.014***	19.8	39.9	19.8	39.9	0
Suspended or expelled before grade 10	3.7	18.9	4.4	20.4	0.007***	2.2	14.7	2.2	14.7	0
Attended one school in grade 9	91.4	28.1	92.2	26.7		95.4	21.0	95.4	21.0	
Grade 9 grade point average	2.67	1.08	2.58	1.00	–0.088***	2.68	0.96	2.68	0.95	0.001
Grade 8 English language arts state assessment score (standardized)	0.053	0.999	–0.150	1.001	–0.203***	–0.054	0.927	–0.060	0.929	–0.006
Grade 8 math state assessment score (standardized)	0.085	1.021	–0.130	0.971	–0.215***	–0.038	0.916	–0.044	0.912	–0.006
Observations	526,576		176,861			421,021		155,083		

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data.

I conducted the analyses described in section 6.1 for all students and for the following groups of students separately: each racial/ethnic group, students who were ever or never eligible for free or reduced-price lunch, current, former, and never English learners, and students attending schools with different urbanicities (i.e., urban/suburban, fringe, distant, and remote).

6.2 Results

On balance, results suggest that HB 1546 had a positive impact on grade 10 student enrollment in CHS courses. Enrollment in CHS courses among grade 10 students has generally grown every year since 2009/10 across most student groups, with a large leap between 2016/17 and 2017/18. Estimates from ITS models support descriptive evidence of the policy's positive influence on grade 10 CHS enrollment. In addition, the CITS analysis found several positive associations with attending an eligible school after HB 1546 was implemented. These suggest that the policy may be contributing to a narrowing of the gap in CHS course-taking between the underrepresented students that schools eligible for CHS subsidies serve and their peers attending ineligible schools. Below, a discussion of descriptive findings is followed by an explanation of findings from the ITS and CITS analyses.

6.2.1 Trends in Accelerated Learning Option Course-taking Over Time

The percentage of students enrolled in CHS courses increased steadily between 2009/10 and 2016/17, from 2 percent to 7 percent, then jumped to 11 percent in in 2017/18 (table 6.3). The average number of high school credits earned in CHS courses remained constant over time, at around 1.5 or 1.6. The marginal increase in credits earned among all students is explained by the increase in participation in CHS courses rather than an increase in the number of CHS courses earned by students who enroll.

Table 6.3. Percentage of grade 10 students who took one or more College in the High School course and the average number of credits earned among enrolled students, 2009/10–2017/18

School Year	Number of grade 10 students	Percent enrolled	Credits earned among all students	Credits earned among enrolled
2009/10	73,741	2.1	0.03	1.2
2010/11	70,661	3.8	0.06	1.5
2011/12	81,052	3.4	0.05	1.5
2012/13	81,409	5.0	0.08	1.6
2013/14	75,015	4.9	0.08	1.6
2014/15	82,682	5.3	0.08	1.6
2015/16	83,974	6.5	0.11	1.6
2016/17	84,025	6.8	0.11	1.6
2017/18	83,215	11.1	0.18	1.6

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data.

Figure 6.1 represents this pattern. It is likely that the trend prior to the implementation of HB 1546 would predict no effect of the policy in the first two years of implementation. The large increase between 2016/17 and 2017/18 changes the post-implementation slope dramatically. It is evident that the post-implementation data are better fit by a quadratic model while the pre-implementation data are fit best with a linear model. Additionally, because the last year of data presents a strong break from the trend, the ITS and CITS results should be interpreted with caution until data from 2018/19 and beyond can confirm whether the 2017/18 result forms part of a new trend or is merely an outlier.

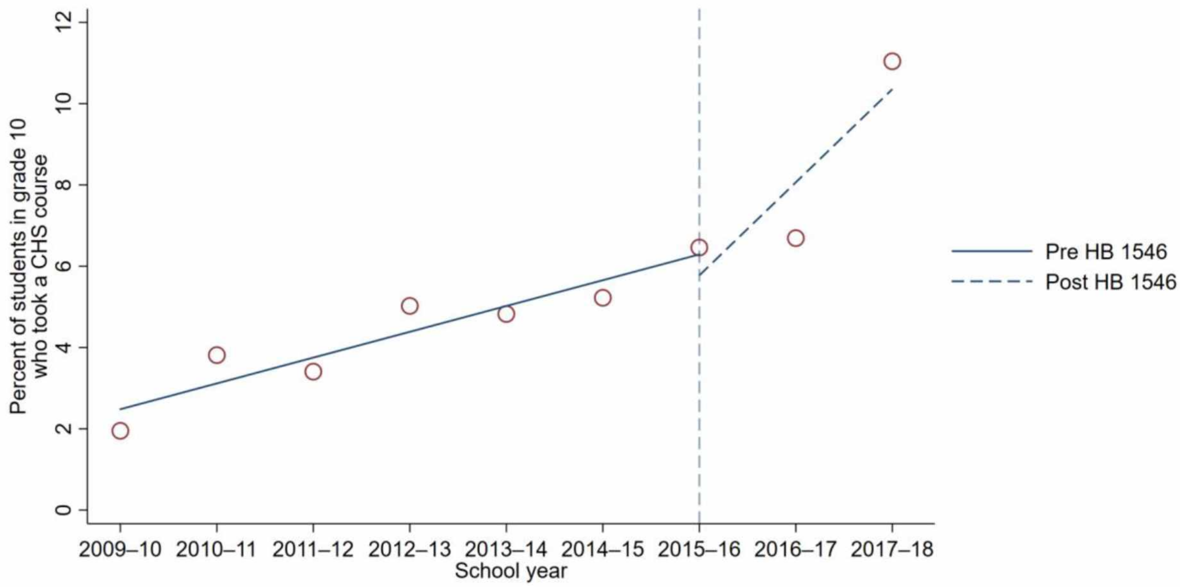

Figure 6.1. Percentage of grade 10 students who took one or more College in the High School (CHS) course, 2009/10–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data.

6.2.1.1 Variation in Trends Over Time Among Key Student Groups

The series of graphs below display trends in CHS course enrollment for students from different racial/ethnic groups, for students eligible for free or reduced-price lunch and English learners, and for students attending schools with different urbanicities. To begin, the pattern observed above is similar for students from each racial/ethnic group (figure 6.2). There are, however, persistent gaps in the percentage of students who enroll in CHS courses among each racial/ethnic group. Over the past several years, the percentage of Asian students who enrolled in CHS courses was about four percentage points higher than the percentage of students from other racial/ethnic backgrounds enrolling in CHS courses. In addition, while most racial/ethnic groups saw a large increase in the percentage of students enrolling in CHS courses between 2016/17 and 2017/18, American Indian/Alaska Native and Black students saw only marginal growth.

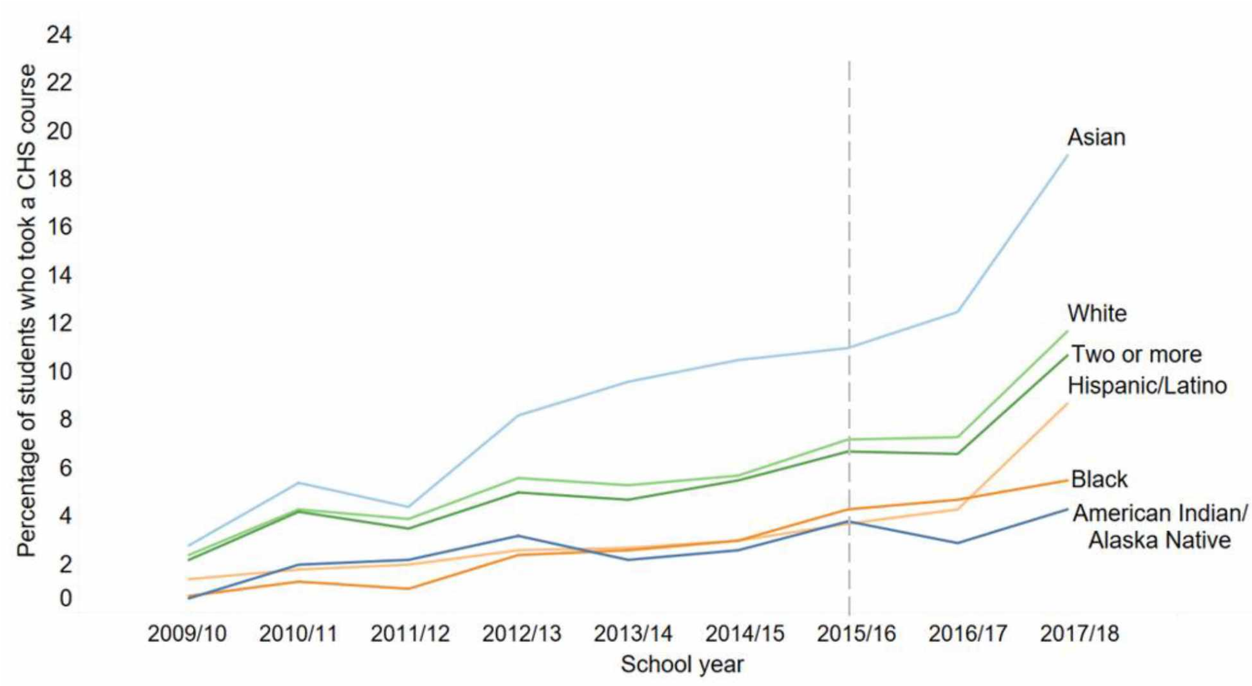

Figure 6.2. Percentage of students who took a College in the High School (CHS) course, by race/ethnicity and school year, 2009/10–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data.

Furthermore, trends in the percentage of students enrolling in CHS courses followed a similar pattern across groups of students by their eligibility for free or reduced-price lunch and English learner services (figure 6.3). Most groups saw gradual increases until 2016/17, then a sharp increase in participation in 2017/18. Notably, there was little difference in the percentage of former English learners and never English learners who enrolled in CHS courses. That is, students who reclassified as English proficient before high school were as likely to participate in CHS courses as students who were never English learners. It is also noteworthy that some students who were still English learners in grades 9 or 10 enrolled in CHS courses in 2017/18 at a rate similar to that of students who had never been English learners in 2013/14.

On the other hand, students who had never been eligible for free or reduced-price lunch enrolled in CHS courses at substantially higher rates than students who had ever been eligible for free or reduced-price lunch. This pattern corresponds to gaps in their prior achievement. Students who experience poverty had, on average, lower grade 8 and high school state assessment scores and lower grade 9 grade point averages. They also had higher rates of other risk factors such as exclusionary discipline, low attendance, and high mobility.

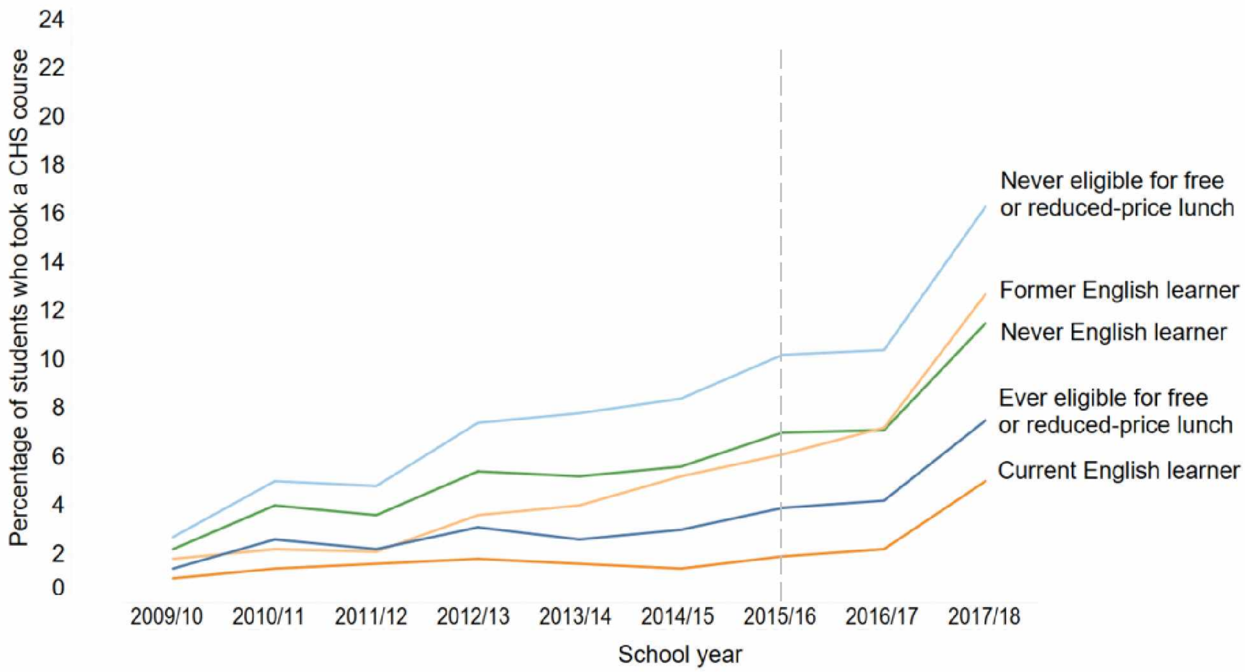

Figure 6.3. Percentage of students who took a College in the High School (CHS) course, by federal program status and school year, 2009/10–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data.

Apart from a surge in participation among students in fringe schools in 2010/11 and 2011/12, between 0.3 and 3.8 percent of students in fringe, distant, and remote schools took a CHS course before HB 1546 (figure 6.4). The participation rate among urban/suburban schools gradually increased from 2 percent in 2009/10 to 11.2 percent in 2017/18, with an increase of 3.4 percentage points in the post-implementation years between 2015/16 and 2017/18.

In contrast, after experiencing low and stagnant CHS course participation rates before HB 1546, students in distant schools saw sharp increases in CHS participation each year after HB

1546 until surpassing the participation rate among students in urban and suburban schools in 2017/18. Specifically, 0.7 percent of students in distant schools took a CHS course in 2014/15 and 11.7 percent did so in 2017/18. This may, in part, be driven by HB 1546's funding priorities. In 2016/17 and 2017/18, 44 percent of students attending distant schools attended a school that was awarded CHS subsidies, compared to 25 percent of students in remote schools, 17 percent of students in fringe schools, and 14 percent of students in urban/suburban schools. Moreover, distant schools represented half of the students in schools that received Tier 1 funding and 48 percent of students in schools that received Tier 2 funding.

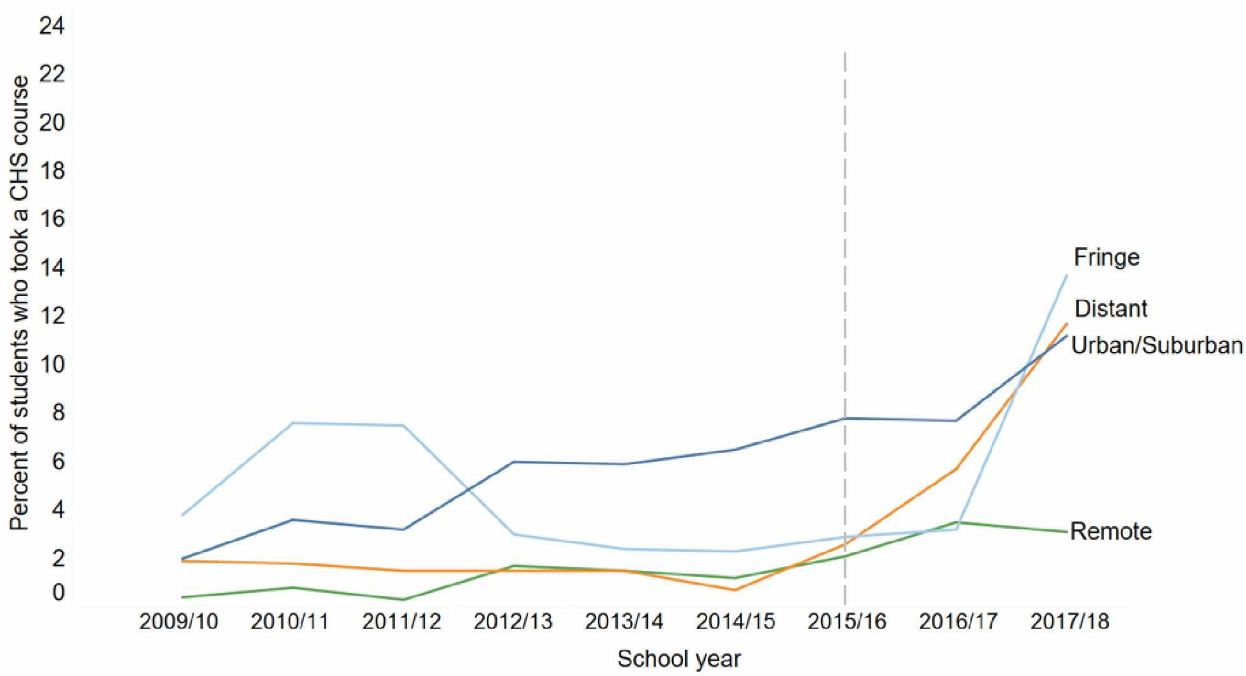

Figure 6.4. Percentage of students who took a College in the High School (CHS) course, by school urbanicity and school year, 2009/10–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data.

6.2.2 Impacts of HB 1546 on Grade 10 College in the High School Course-taking Outcomes

Among the matched sample of students, results of the ITS analysis show that students who were in grade 10 in 2017/18 had more than double the odds of participating in a CHS course than they would have had without HB 1546 in place (table 6.4). As estimated by the saturated ITS model, their odds are four times higher than predicted by the pre-HB 1546 trend. The policy also had a small, but statistically significant effect on the number of high school CHS credits grade 10 students earned in 2017/18. Specifically, the policy increased the average number of credits earned about 0.1 credits over baseline trends.

Overall, effects for the full, unmatched sample tended to be higher and, with a larger sample size contributing power, were also more frequently statistically significant. Additionally, results from the saturated model yielded slightly higher effects for all groups. It is worth noting that effects from 2015/16 and 2016/17, which are not shown, tended to be positive or neutral and not statistically significant. When interpreting the small coefficients on credits earned in CHS courses, it is important to remember that credits earned are averaged among all students regardless of whether they participated in a CHS course. That is, the number of credits earned by any student who did not enroll in a CHS course was 0, resulting in very small averages as shown in table 6.3. Further, some groups began with only one or two percent of students enrolled in a CHS course. Large odds ratios do not necessarily translate to large percentage-point gains in CHS enrollment, but can at least provide a measure of the direction outcomes are moving in post-HB 1546.

Table 6.4. Effects of the HB 1546 Policy on the Number of High School (CHS) Credits Earned in College in the High School in the Third Year of Implementation, 2017/18

		Took a CHS course (Odds ratios)		Credits earned in CHS courses	
		Model specification			
Group	**Sample**	**Standard**	**Saturated**	**Standard**	**Saturated**
All students	All students	3.154*	4.475**	0.096*	1.481**
	N = 729,644	(1.464)	(2.072)	(0.038)	(0.461)
	Matched	2.750*	4.061**	0.102*	0.137**
	N = 477,069	(1.311)	(1.917)	(0.043)	(0.045)
Race/ethnicity					
American Indian/Alaska Native	All students	12.256*	20.93**	0.076*	0.0930*
	N = 18,413	(11.893)	(21.16)	(0.036)	(0.0382)
	Matched	19.277	37.34	0.131	0.157
	N = 3,642	(42.662)	(87.30)	(0.101)	(0.099)
Asian	All students	1.533	2.106	0.050	0.0891
	N = 54,049	(0.750)	(1.184)	(0.073)	(0.0811)
	Matched	1.855	2.586	0.056	0.103
	N = 26,896	(1.094)	(1.762)	(0.115)	(0.126)
Black	All students	1.703	2.000	0.008	0.0156
	N = 34,579	(2.867)	(2.187)	(0.043)	(0.0426)
	Matched	2.718	3.909	0.047	0.0647
	N = 10,569	(4.631)	(6.971)	(0.060)	(0.0624)
Hispanic/Latino	All students	3.142*	4.936**	0.066**	0.0922***
	N = 137,351	(1.600)	(2.627)	(0.023)	(0.0247)
	Matched	3.323	5.147*	0.073*	0.0984**
	N = 66,762	(2.199)	(3.595)	(0.032)	(0.0335)
Two or more races	All students	2.382	3.621	0.072	0.106*
	N = 41,510	(1.605)	(2.478)	(0.053)	(0.0535)
	Matched	2.953	4.471	0.077	0.110
	N = 19,758	(2.237)	(3.528)	(0.069)	(0.0758)
White	All students	3.629*	5.070**	0.116*	0.147**
	N = 443,742	(1.978)	(2.699)	(0.049)	(0.0493)
	Matched	2.861	4.259**	0.113*	0.151**
	N = 349,440	(1.590)	(2.286)	(0.051)	(0.0522)
Federal program status					
Ever eligible for free or reduced-price lunch	All students	4.318*	6.487**	0.084**	0.103**
	N = 403,438	(2.796)	(4.143)	(0.032)	(0.0320)
	Matched	3.941*	5.960**	0.087*	0.110**
	N = 223,004	(2.674)	(3.980)	(0.039)	(0.0391)
Never eligible for free or reduced-price lunch	All students	2.562*	3.512**	0.095	0.135*
	N = 326,206	(1.109)	(1.557)	(0.054)	(0.0572)
	Matched	2.155	3.127*	0.089	0.138*
	N = 248,551	(0.983)	(1.449)	(0.060)	(0.0637)

Table 6.4 (continued).

		Took a CHS course (Odds ratios)		Credits earned in CHS courses	
		Model specification			
Group	**Sample**	**Standard**	**Saturated**	**Standard**	**Saturated**
Current English learner	All students	13.166**	22.17**	0.058**	0.0728***
	N = 45,119	(12.609)	(22.09)	(0.020)	(0.0215)
	Matched	12.749	18.16	0.085	0.101
	N = 14,995	(24.328)	(36.28)	(0.049)	(0.0523)
Former English learner	All students	0.952	1.464	0.027	0.0614
	N = 73,395	(0.519)	(0.864)	(0.047)	(0.0493)
	Matched	0.880	1.164	0.009	0.0303
	N = 35,543	(0.728)	(1.027)	(0.079)	(0.0802)
Never English learner	All students	3.326*	4.656**	0.104*	0.133**
	N = 611,130	(1.625)	(2.249)	(0.042)	(0.0432)
	Matched	2.966*	4.428**	0.110*	0.148**
	N = 426,530	(1.494)	(2.181)	(0.047)	(0.0484)
School urbanicity					
Urban/suburban	All students	2.166	3.096*	0.058	0.0831
	N = 524,564	(0.993)	(1.469)	(0.051)	(0.0534)
	Matched	1.776	2.621	0.056	0.0861
	N = 337,785	(0.854)	(1.303)	(0.059)	(0.0630)
Fringe	All students	227.145**	419.7**	0.336**	0.412**
	N = 92,949	(418.980)	(779.0)	(0.120)	(0.146)
	Matched	207.351**	415.3**	0.365**	0.459**
	N = 66,021	(393.686)	(796.3)	(0.138)	(0.172)
Distant	All students	57.240***	60.25***	0.139***	0.162**
	N = 70,069	(62.505)	(68.47)	(0.038)	(0.0507)
	Matched	48.925**	47.90**	0.148**	0.173**
	N = 45,964	(68.692)	(70.10)	(0.046)	(0.0580)
Remote	All students	2.759	1.420	0.008	-0.00320
	N = 42,062	(6.680)	(3.142)	(0.037)	(0.0366)
	Matched	2.337	1.143	0.006	-0.0138
	N = 27,297	(6.190)	(2.773)	(0.058)	(0.0593)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Each cell represents a separate student-level specification estimating treatment effects in 2017/18. Standard models estimate the outcomes as a function of an indicator for whether the school year the student was in grade 10 occurred after the implementation of HB 1546 (2015/16), school year centered around the first intervention year, 2015/16, a squared term for school year, an interaction between school year and the indicator for whether the student was in grade 10 after HB 1546 implementation, binary indicators for gender, race/ethnicity, eligibility for free and reduced-price lunch, migrant programs, or English language development services, whether the student was suspended or expelled before grade 10, whether the student was suspended or expelled in grade 10, whether the student was chronically absent in grade 9, and whether the student attended one school in grade 9, English as a home or primary language, and continuous predictors for grade 8 English language arts and math state assessment scores standardized within school year, grade level, and test type to have a mean of 0 and a standard deviation of 1, and grade 9 grade point average.

Table notes continue on the next page.

Table 6.4 table notes (continued).

School-level covariates included the percentage of students in the school eligible for free or reduced-price lunch, the number of students enrolled, and the urbanicity of the school (fringe, distant, or remote, relative to urban/suburban). Saturated models estimate outcomes as a function of school year, centered around the first intervention year, a squared term for school year, and binary indicators for each of the three implementation years (2015/16, 2016/17, and 2017/18). The same student- and school-level covariates are included in saturated models. Coefficients for the binary outcome of taking a CHS course are reported in odds ratios.
Source: Author's analysis of Washington Office of Superintendent of Public Instruction data.

6.2.2.1 Variation in results among key student groups

As displayed in figures 6.2, 6.3, and 6.4, trends in CHS participation vary across student groups. Likewise, most, but not all groups experienced an increase in CHS course enrollment in 2017/18. These trends are reflected in the ITS analysis. Each cell in table 6.4 represents a separate estimation of either the probability of enrolling in a CHS course (measured in odds ratios) or the number of CHS credits earned. Each row describes the estimation sample. For example, among all Hispanic/Latino students, those who were in grade 10 post-HB 1546 earned, on average, 0.07 credits more in the third year of implementation than predicted by the pre-HB 1546 trend (or 0.09 credits more according to the saturated model). Results in the third year of implementation were positive or neutral for all racial/ethnic groups. They were also statistically significant among American Indian/Alaska Native, Hispanic/Latino, and White students. While matched samples tended to yield larger positive coefficients, smaller sample sizes may lack power to demonstrate significant results. This is particularly true for American Indian/Alaska Native students, a group with a small sample size in which only 1 in 6 students made it to the matched sample.

Grade 10 students who were ever or never eligible for free or reduced-price lunch saw statistically significant increases in the likelihood of CHS course enrollment and the number of CHS credits earned. Among students who were ever eligible for free or reduced-price lunch, the odds of taking a CHS course in 2017/18 were 4.3 times higher than predicted by the pre-HB 1546 trend.

Grade 10 current English learners also saw large increases, but these represent modest gains since they started out with virtually no participation in CHS courses (figure 20). It is worth noting that only a third of current English learners matched between pre- and post-HB 1546 samples, and likewise large coefficients did not translate to statistically significant results among the matched sample. Former English learners began increasing their participation in CHS courses years before HB 1546, which set a different expectation for their post-HB 1546 results. Thus, the results suggest that CHS outcomes in 2017/18 are as anticipated had the policy not been implemented. Students who were never English learners, however, also experienced significant increases in CHS course-taking outcomes relative to pre-HB 1546 trends.

Finally, results from students attending schools with different urbanicities reflect patterns shown in figure 21. Students attending distant and fringe schools, many of which are targeted with Tier 1 and Tier 2 subsidies, made tremendous gains above predictions based on pre-HB 1546 trends. Students in urban/suburban schools made gains, but not substantially beyond what was expected given their participation in CHS courses had been steadily rising before HB 1546. Finally, remote schools saw moderate gains in CHS course enrollment—not enough to be statistically significantly different from their pre-HB 1546 trend—and no changes in credits earned.

Overall, results in the third year of implementation suggest that offering students in grade 10 the opportunity to earn dual credit, combined with other policy emphases that expand and encourage access, can positively impact CHS participation and credit accrual. Students from several underrepresented groups had large and statistically significant results. This implies that the policy benefits both those students who already had a strong inclination to take dual credit courses and those who have not typically accessed them before.

6.2.3 Comparing Impacts of HB 1546 on Grade 10 College in the High School Course-taking Outcomes Between Students in Schools that are Eligible for College in the High School Tuition Subsidies and Students in Ineligible Schools

Until the implementation of HB 1546, participation in CHS courses and the average number of credits earned in them had been persistently low among grade 10 students in schools eligible for CHS subsidies (figure 6.5). In contrast, participation in CHS courses had been rising steadily since the 2009/10 school year in schools that were not eligible for CHS subsidies. This began to change with the implementation of HB 1546. During the first two years of implementation (2015/16 and 2016/17), participation rates for students in eligible schools began gradually rising. The slope of the increase in participation mimicked that of students in schools that were not eligible for subsidies. Then, in 2017/18, participation in CHS courses rose dramatically for both eligible and ineligible schools, to a level at least 4 percentage points higher than in any other school year since 2009/10 (from 2.5 to 6.2 percent for eligible schools and from 8.5 to 13.3 for ineligible schools).

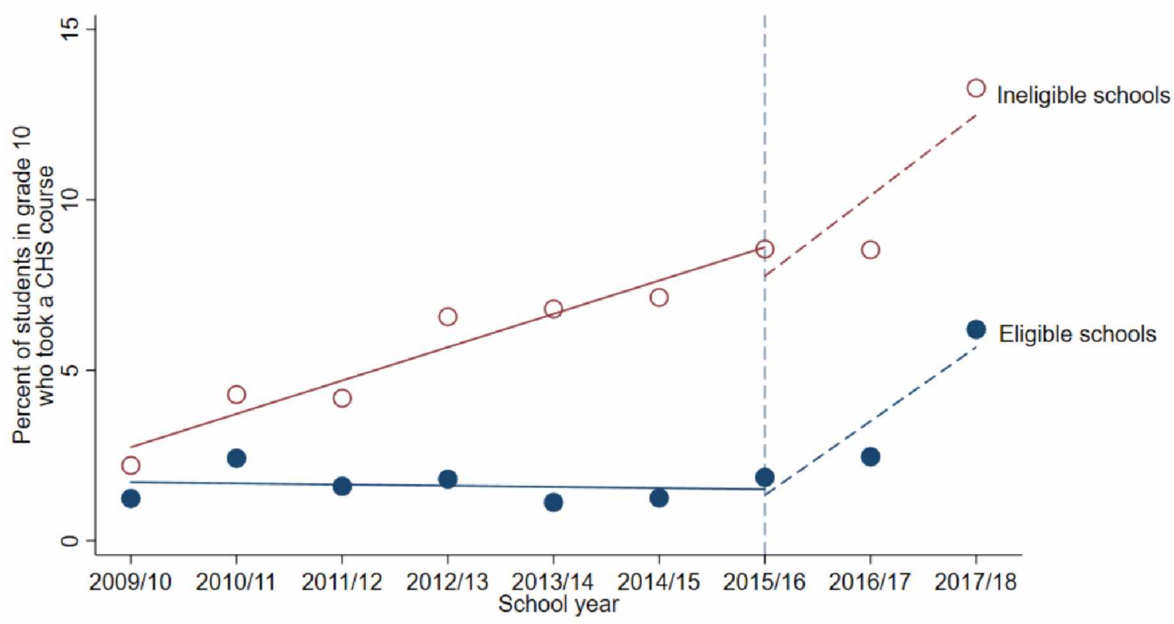

Figure 6.5. Percentage of grade 10 students who took a College in the High School (CHS) course, by HB 1546 eligibility status, 2009/10–2017/18

Source: Author's analysis of Washington Office of Superintendent of Public Instruction data.

The question that visual inspection of the trends in figure 22 does not clearly answer is whether increases in CHS participation rates and credits earned in eligible schools outpaced the increases experienced among ineligible schools. If this is true, it means that HB 1546 is helping to close gaps in participation for students in eligible schools and not simply preventing them from widening. Alternatively, if the rate of growth in participation in CHS courses is lower in eligible schools than that in ineligible schools, it means the gap is widening, although perhaps not as dramatically as it could have been if the pre-HB 1546 trend continued in 2015/16–2017/18.

The results of the comparative interrupted time series presented in table 6.5 provide evidence to answer that question. They suggest that gaps in CHS course participation between eligible and ineligible schools may, for some student groups, be narrowing as a result of HB 1546. However, while many estimates were positive, few were statistically significant, despite often large sample sizes. As in table 6.4, each cell represents a separate estimate of the result for the group indicated. The mean difference represents the difference in eligible and ineligible school group means from before to after HB 1546, as estimated by the *Eligible* $\times$ *Postpolicy* term in equations 6.6 and 6.7. The slope references the difference between eligible and ineligible schools in the rate at which CHS course-taking outcomes are changing, as estimated by the *Eligible* $\times$ *Postpolicy* $\times$ *Year* term in equations 6.6 and 6.7. Finally, the 2017/18 estimate represents the difference between the groups in the final year, akin to the results from the standard models in table 6.4.

Among all students, the mean and slope differences were positive and statistically significant with respect to CHS course enrollment. In other words, relative to students in ineligible schools, students in eligible schools experienced greater gains in CHS participation. The slope difference, however, loses statistical significance among the matched sample of students from eligible and ineligible schools. There were also no differences between the groups in CHS credits earned.

Table 6.5. Effects of the HB 1546 Policy on the Number of High School Credits (CHS) Earned in College in the High School Courses in the Third Year of Implementation Among Schools Eligible for College in the High School Subsidies, 2017/18

		Measure of difference between eligible and ineligible schools					
		Took a CHS course			**Credits earned in CHS courses**		
Group	**Sample**	**Mean**	**Slope**	**2017/18 estimate**	**Mean**	**Slope**	**2017/18 estimate**
All students	All students	1.945*	1.605*	1.569	0.0247	0.0176	0.002
	N = 703,334	(0.535)	(0.387)	(0.499)	(0.0183)	(0.0207)	(0.037)
	Matched	1.980*	1.488	1.559	0.0279	0.0175	0.021
	N = 512,848	(0.555)	(0.364)	(0.487)	(0.0184)	(0.0223)	(0.037)
Race/ethnicity							
American Indian/Alaska Native	All students	1.847	1.537	1.517	0.000352	0.0192	0.012
	N = 17,803	(0.911)	(0.522)	(0.592)	(0.0200)	(0.0148)	(0.023)
	Matched	1.025	1.910	2.869	-0.0257	0.0377	0.049
	N = 5,679	(1.039)	(0.943)	(1.635)	(0.0517)	(0.0273)	(0.033)
Asian	All students	2.537	1.504	1.051	0.0911	0.0124	–0.062
	N = 53,349	(1.214)	(0.444)	(0.506)	(0.0484)	(0.0364)	(0.072)
	Matched	2.301	1.662	1.358	0.0995*	0.0465	0.0001
	N = 25,142	(1.116)	(0.491)	(0.632)	(0.0495)	(0.0374)	(0.999)
Black	All students	1.867	2.376**	1.079	0.00304	0.0190	–0.024
	N = 33,670	(1.189)	(0.760)	(0.591)	(0.0228)	(0.0142)	(0.029)
	Matched	1.752	2.423*	1.108	-0.00453	0.0235	–0.176
	N = 13,891	(1.465)	(0.865)	(0.688)	(0.0340)	(0.0182)	(0.035)
Hispanic/Latino	All students	1.330	1.861*	2.399*	-0.00103	0.0230	0.032
	N = 132,740	(0.394)	(0.498)	(0.826)	(0.0154)	(0.0165)	(0.034)
	Matched	1.461	1.559	2.345*	0.00475	0.0172	0.038
	N = 85,556	(0.470)	(0.431)	(0.853)	(0.0176)	(0.0170)	(0.035)
Two or more races	All students	1.476	1.968*	1.548	0.0125	0.0401	0.007
	N = 40,172	(0.613)	(0.589)	(0.598)	(0.0300)	(0.0289)	(0.040)
	Matched	1.364	1.830	1.523	0.00390	0.0424	0.029
	N = 20,430	(0.699)	(0.589)	(0.611)	(0.0379)	(0.0339)	(0.045)

Table 6.5 (continued).

		Measure of difference between eligible and ineligible schools					
		Took a CHS course			**Credits earned in CHS courses**		
Group	**Sample**	**Mean**	**Slope**	**2017/18 estimate**	**Mean**	**Slope**	**2017/18 estimate**
White	All students	2.124**	1.441	1.392	0.0339	0.0114	0.0005
	N = 425,600	(0.609)	(0.378)	(0.459)	(0.0206)	(0.0276)	(0.044)
	Matched	2.188**	1.408	1.417	0.0363	0.0114	0.013
	N = 362,148	(0.644)	(0.377)	(0.461)	(0.0206)	(0.0289)	(0.044)
Federal program status							
Ever eligible for free or reduced-price lunch	All students	1.581	1.773*	0.645*	0.00349	0.0230	0.0249
	N = 387,735	(0.530)	(0.424)	(0.318)	(0.0145)	(0.0140)	(0.0275)
	Matched	1.709	1.522	1.823	0.0110	0.0171	0.026
	N = 265,352	(0.581)	(0.366)	(0.582)	(0.0158)	(0.0145)	(0.028)
Never eligible for free or reduced-price lunch	All students	2.314**	1.425	0.243	0.0564*	0.00554	–0.016
	N = 315,599	(0.618)	(0.419)	(0.362)	(0.0287)	(0.0449)	(0.067)
	Matched	2.322**	1.478	1.397	0.0541	0.0122	0.006
	N = 244,272	(0.623)	(0.439)	(0.489)	(0.0279)	(0.0469)	(0.069)
Current English learner	All students	1.186	1.405	1.732	0.000860	0.00396	0.005
	N = 43,786	(0.572)	(0.446)	(0.692)	(0.00969)	(0.00909)	(0.017)
	Matched	1.327	1.413	2.206	0.000286	0.00944	0.020
	N = 21,066	(0.720)	(0.532)	(0.936)	(0.0111)	(0.0105)	(0.020)
Former English learner	All students	1.327	1.730*	1.906	0.00382	0.0217	0.0008
	N = 71,273	(0.480)	(0.481)	(0.765)	(0.0274)	(0.0254)	(0.053)
	Matched	1.521	1.435	2.009	0.0156	0.0125	0.027
	N = 41,050	(0.600)	(0.413)	(0.800)	(0.0255)	(0.0232)	(0.048)
Never English learner	All students	2.066*	1.550	1.485	0.0303	0.0167	0.003
	N = 588,275	(0.588)	(0.398)	(0.489)	(0.0203)	(0.0251)	(0.041)
	Matched	2.038*	1.494	1.515	0.0303	0.0175	0.020
	N = 450,233	(0.594)	(0.390)	(0.492)	(0.0203)	(0.0268)	(0.042)

Table 6.5 (continued).

		Measure of difference between eligible and ineligible schools					
		Took a CHS course			**Credits earned in CHS courses**		
Group	**Sample**	**Mean**	**Slope**	**2017/18 estimate**	**Mean**	**Slope**	**2017/18 estimate**
School urbanicity							
Urban/suburban	All students	2.300*	1.484	1.222	0.0356	0.0114	–0.036
	N = 510,190	(0.807)	(0.553)	(0.504)	(0.0250)	(0.0337)	(0.047)
	Matched	2.425*	1.356	1.087	0.0431	0.00426	–0,025
	N = 363,257	(0.869)	(0.505)	(0.484)	(0.0258)	(0.0361)	(0.047)
Fringe	All students	0.394	1.124	2.465	-0.0266	0.0148	0.037
	N = 82,508	(0.245)	(1.091)	(1.837)	(0.0527)	(0.0985)	(0.143)
	Matched	0.388	1.088	2.707	-0.0352	0.0440	0.081
	N = 64,984	(0.253)	(1.063)	(2.023)	(0.0547)	(0.0898)	(0.131)
Distant	All students	0.731	1.113	1.265	0.0119	0.000377	0.009
	N = 69,090	(0.752)	(0.686)	(0.691)	(0.0278)	(0.0510)	(0.085)
	Matched	1.403	1.283	1.295	0.0225	0.0146	0.033
	N = 52,720	(1.585)	(0.860)	(0.704)	(0.0290)	(0.0484)	(0.078)
Remote	All students	0.662	0.405	5.213*	0.0389	-0.0203	0.097
	N = 41,546	(0.878)	(0.246)	(3.337)	(0.0379)	(0.0229)	(0.044)
	Matched	0.916	0.438	5.707*	0.0477	-0.0203	0.107*
	N = 30,498	(1.143)	(0.263)	(3.327)	(0.0379)	(0.0251)	(0.048)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Each cell represents a separate student-level specification estimating treatment effects. Models estimate outcomes as a function of an indicator for whether the student was enrolled in a school eligible for CHS subsidies, school year centered around the first intervention year, 2015/16, a squared term for school year, an indicator for whether the student was enrolled in grade 10 after HB 1546 was implemented (2015/16–2017/18), an interaction between school year and the indicator for whether the student was enrolled in a school eligible for CHS subsidies, an interaction among school year, the indicator for whether the student was enrolled in a school eligible for CHS subsidies, and the indicator for whether the student was enrolled in grade 10 after HB 1546 was implemented, binary indicators for gender, race/ethnicity, eligibility for free and reduced-price lunch, migrant programs, or English language development services, whether the student was suspended or expelled before grade 10, whether the student was chronically absent in grade 9, whether the student attended one school in grade 9, and whether the student spoke English as a home or primary language, and continuous predictors for grade 8 English language arts and math state assessment scores standardized within school year, grade level, and test type to have a mean of 0 and a standard deviation of 1, and grade 9 grade point average. School-level covariates included the percentage of students in the school eligible for free or reduced-price lunch, the number of students enrolled, and the urbanicity of the school (fringe, distant, or remote, relative to urban/suburban). Coefficients for the binary outcome of taking a CHS course are reported in odds ratios.
Source: Author’s analysis of Washington Office of Superintendent of Public Instruction data.

6.2.3.1 Variation in Results Among Key Student Groups

The pattern observed among all students—a positive effect of the policy on changes in CHS course enrollment and the null effect on changes in CHS credits earned—is generally consistent across student groups. There were some notable differences when comparing outcomes within subsamples of students attending eligible and ineligible schools, however. Certain results suggest that grade 10 students' access to CHS courses in eligible schools may favor groups that are already well represented among accelerated learning option course-takers. Specifically, White students in eligible schools had pre- and post-treatment mean differences in the probability of enrolling in a CHS course that were twice as high as the pre- and post-treatment mean differences among their counterparts in ineligible schools. This result was consistent between the sample of all students and the matched sample. A similar result is found for students who were never eligible for free or reduced-price lunch relative to students were ever eligible for free or reduced-price lunch, students who were never English learners relative to current and former English learners, and students attending urban and suburban schools relative to students attending fringe, distant, or remote schools. This means that students from more privileged groups within eligible schools are experiencing faster gains in CHS course participation relative to their White, higher-income, English-speaking, or urban/suburban peers in ineligible schools than the gains of students from underrepresented groups compared to their counterparts in ineligible schools.

Nevertheless, some results suggest that the policy may also benefit students from underrepresented groups. Among them, Black students in eligible schools appear to be outpacing the rate of increase in CHS course enrollment experienced by Black students in ineligible schools. This result is consistent between matched and full samples of students. Policy impacts on the difference in slope among students from other groups, such as Hispanic/Latino students and students with two or more races, were statistically significant for the full samples, but not the matched samples of students.

Positive estimates of the policy's impact in 2017/18 were statistically significant among all Hispanic/Latino students and among the matched sample of Hispanic/Latino students. Grade 10 Hispanic/Latino students in eligible schools had more than double the odds of enrolling in a CHS course than those of grade 10 Hispanic/Latino students in ineligible schools. Further, though only a few are statistically significant, estimates are positive for students who were ever eligible for free or reduced-price lunch, and for current and former English learners.

Finally, it is noteworthy that students attending eligible fringe, distant, and remote schools—schools that often benefit from Tier 1 and Tier 2 subsidies—had no better results than students attending ineligible schools in the same locale categories. The exception is for students attending remote schools, where eligible schools saw a five-fold increase in the odds of participating in CHS courses in 2017/18 compared to students in remote ineligible schools. However, this result should be interpreted with caution given the negative, but not statistically significantly different, mean and slope differences.

6.3 Discussion

The findings from these analyses provide a promising outlook for HB 1546's impact on grade 10 students' enrollment in CHS courses. The policy's consistently positive, often statistically significant relationships with increases in CHS course enrollment imply that a diverse group of students was prepared and able to participate in CHS courses and took advantage of the opportunity to earn dual credit that was not previously possible. The results suggest that the policy does not simply recognize credits earned by students who would have participated in these courses anyway but encourages students who may not have participated without the benefit of earning dual credit to enroll.

Positive gains are apparent among underrepresented students from different racial/ethnic, linguistic, socioeconomic, and urbanicity backgrounds. This is true even though the state does not subsidize CHS tuition for students in grade 10. This contradicts other research that shows that as dual credit participation increases, so do gaps between privileged and underserved students (Miller, et al., 2018; Pierson, Hodara & Luke, 2017).

Nevertheless, the effects for higher-income, White, English-speaking, and urban/suburban students were large, positive, and statistically significant among full and matched samples. As discussed in chapter 5, HB 1546 is designed to benefit students who are prepared for accelerated learning option coursework, and lowers the cost of participation for students whose obstacles include distance to a college that offers Running Start, attending a small school with limited course offerings, and attending a high-poverty school. Students among the demographic groups within eligible schools that show clear positive impacts of HB 1546 on CHS course enrollment may not face the same challenges to participation as their classmates who have, for example, lived in poverty or had to learn English after beginning school.

Future studies could examine how students from underrepresented groups access CHS courses within eligible schools to identify local policies and practices that result in successful accelerated learning options experiences for these students. They should verify whether these students take the same types of accelerated learning option courses and earn college credit from CHS courses at the same rate as White students, students from higher socioeconomic statuses, native English speakers, and students from urban and suburban areas.

6.4 Limitations

The results presented in this section reflect implementation effects from HB 1546 on grade 10 CHS course-taking in its first three years. The most recent year of data happened to have unusually high CHS enrollment rates relative to previous years. This may be an impact of the policy, but it is necessary to continue to monitor policy effects to determine if these estimates describe a sustainable trend or capture an outlier. Although it was not evident in public information that any other intervention could have increased participation in CHS courses in 2017/18, qualitative follow-up with state policymakers and local education leaders may help confirm whether the increase shown in this study should be fully attributable to policy changes driven by HB 1546.

7.0 Discussion and Implications

This dissertation provides rigorous quasi-experimental policy impact evidence to a body of literature comprised primarily of descriptive summaries of policy components, correlational studies, and studies based on comparing outcomes for matched samples of treatment and comparison groups. It illustrates the landscape of accelerated learning option course-taking in Washington state over the past decade with an emphasis on patterns and trends for student groups who are traditionally underrepresented in accelerated learning option courses and, by extension, in higher education. It continues by estimating causal impacts of two components of the policy—subsidies for CHS tuition in schools serving underrepresented populations and the extension of the opportunity to earn college credit during high school to students in grade 10. The findings yield information that may be insightful for ongoing implementation of HB 1546 and related policies and raised questions that can be addressed through future investigation.

7.1 Implications of Study Findings

In chapter 4, it found that participation in accelerated learning option courses has increased, a trend that applied to all demographic groups studied. Findings also showed that students tend to take courses that can count towards a postsecondary degree and, as such, reduce the cost and time needed to earn a credential. It also found large and persistent disparities in accelerated learning option course-taking for students who were ever eligible for free or reduced-price lunch, current English learners, and students from remote schools. The findings offer a couple of implications for consideration:

1. **Comprehensive rather than piecemeal changes may be needed to close gaps in accelerated learning option course participation for students who have experienced poverty.**

Many interventions designed to improve participation in college preparatory coursework are targeted to secondary students. This may be too late for some students who enter high school with low academic skills after substandard or interrupted educational experiences during elementary and middle school, and who may have constraints on their ability to catch up as a result of food and housing insecurity, emotional trauma, and the necessity to work or provide childcare after school to help their families. Real progress on closing the gap in accelerated learning option course participation among these students is likely to take long-term efforts, coordinated across education and other social and economic systems.

In the meantime, there may be some relatively low-cost approaches to improving readiness for accelerated learning option courses. To start, improving understanding among elementary and middle school educators of the existence, requirements, and demands of accelerated learning options classes in high school may help them prepare students for advanced curricula by prioritizing essential skills and content early on. In addition, teachers may need training on how to prepare students for success in more demanding courses. Part of the training could support a deeper understanding of cultural and socioemotional factors to help teachers recognize, manage, and ameliorate the impacts that the factors mentioned here have on students' academic preparation.

2. **HB 1546's emphasis on funding CHS tuition for distant and small schools may have helped to close gaps for students attending fringe and distant schools, but gaps persist for students attending remote schools.**

Findings indicated that students in remote rural schools may have limited opportunities to participate in accelerated learning option courses. The barriers to implementing programs must be confirmed through future investigation. However, it is likely that these schools have limited resources to hire a sufficient number of faculty with expertise to offer a robust accelerated learning program. These schools are also likely to be far from colleges that offer Running Start courses, leaving students with few choices other than to take dual enrollment courses online. Creative solutions may include collaborations across remote rural districts to share or exchange teachers who meet the requirements for CHS instructors (they must be hired as adjuncts at a college), financially supporting teachers to meet those qualifications through graduate coursework or earning master's degrees, and creating dedicated space within rural schools for distance-based dual enrollment students that can provide the experience of an extension campus within the high school (Diallo, 2017; Mobley, 2014).

In chapter 5, the impact of HB 1546's tuition subsidies on CHS course-taking outcomes was measured for schools near the cutoffs for each of the three eligibility tiers. Few effects were found, but relationships were often positive, albeit not yet consistent or strong enough to achieve statistical significance. Three conclusions can be drawn from the results:

1. **HB 1546 benefitted many students but left students whose schools did not offer CHS courses behind**

Many eligible schools that already had a CHS program applied for and were awarded subsidies (see table 3.2). However, while more schools offered CHS courses in each year of HB

1546 implementation, many eligible schools still did not offer CHS courses as of the 2017/18 school year. Others declined to apply for subsidies. Because HB 1546 is not designed to help schools build new CHS programs beyond offering the opportunity to subsidize students' tuition as motivation for doing so, subsidies are awarded to students in schools with existing programs and administrators who take the initiative to apply for subsidies. This leaves out a nontrivial portion of the population the policy hopes to impact. Furthermore, the results of this study may not apply to schools with no history of CHS offerings. These schools were not included in the regression discontinuity analysis, and therefore the patterns found in estimating the effects of subsidies may not generalize to schools without an established program. On the bright side, if trends in the expansion of CHS offerings continue and HB 1546 funds are sustained or expanded, the policy has the potential to reach all students in its target population.

2. **Inferences about HB 1546's impact on subsidized schools remain uncertain, though some positive associations point to progress being made**

To date, there are no unequivocal relationships between HB 1546's subsidies and the probability of enrolling in a CHS course or the number of CHS credits earned. Many positive relationships between subsidies and CHS course-taking outcomes, found primarily among Tier 1 and Tier 2 schools, lack statistical significance but suggest the policy may be moving outcomes in the right direction. However, there is too much variation in outcomes across eligible schools to ascertain whether this pattern is due to the policy or to chance. As HB 1546 implementation continues, local and state leaders may consider working with eligible schools to help them develop strong programs. This may involve investigating promising practices among schools with consistently successful outcomes and helping other schools implement them.

3. **Some factors that contribute to underrepresentation in accelerated learning option courses among schools eligible for CHS subsidies are not addressed by the policy**

Schools eligible for CHS subsidies, particularly those far from the eligibility cutoffs, serve higher concentrations of students who face barriers to participating in accelerated learning option courses than schools that are ineligible for subsidies. While distance from a college that offers Running Start courses, small enrollment sizes, and high poverty rates each complicate increasing enrollment in accelerated learning option courses, eligible schools also serve students who are, on average, less prepared for advanced coursework, as measured by grade 8 state assessment scores. They also have higher percentages of migrant students and English learners. As designed, HB 1546 helps make sure students who are already prepared to take accelerated learning option courses earn college credit when they pass them. This is an important barrier to remove for students who would otherwise be unable to afford to pay for the credits they earned. Achieving equitable participation in accelerated learning option courses among presently underrepresented groups, however, may require long term and comprehensive efforts to prepare these students for advanced coursework. This includes efforts to accelerate English proficiency and make socioeconomic status less predictive of academic achievement through bolstering the educational experiences of children living in poverty throughout the K–12 continuum.

Chapter 6 showed that HB 1546's extension of eligibility for earning college credits in CHS courses to grade 10 students positively impacted participation in CHS courses. The policy change had less of an impact on the average number of credits students earned in CHS courses, however. Although these patterns were fairly consistent across full and matched samples and among different student groups, the findings leave room for additional consideration:

1. **Ongoing evaluation of policy impacts can strengthen initial positive findings.**

Evidence of HB 1546's impacts on grade 10 participation in CHS courses appear strong and positive. Much of this conclusion is based on the final year of data, 2017/18, when CHS enrollment increased dramatically over previous years. The change in trend between 2016/17 and 2017/18 should be confirmed with data from 2018/19 and beyond to validate the optimistic results of this study.

2. **Impacts for students in fringe and distant schools identified through ITS cannot be explained by priority eligibility for CHS subsidies.**

The ITS models found very large impacts of HB 1546 on grade 10 student enrollment in CHS courses and modest, but significant gains in the average number of CHS credits students earned. However, the CITS analysis revealed that within fringe and distant areas, there was no difference between students in eligible schools and students in ineligible schools in terms of the pre- and post-implementation mean difference, the slope or rate of change in CHS course-taking, or in impacts for the most recent year available (2017/18). This result cannot be explained by data available for this study. Future work may seek to understand the drivers behind the rapid expansion in CHS course-taking among grade 10 students in fringe and rural areas, and examine potential threats to the validity of these results by uncovering other interventions that may have impacted the increase in grade 10 participation in CHS courses.

3. **Compared to students in ineligible schools, HB 1546's impacts on CHS enrollment are strongest among students who are not part of underrepresented groups within eligible schools**

This result reflects the intent of HB 1546 to target students who are prepared for and interested in accelerated learning options to earn credit in them. However, when academic preparation is unequal across racial/ethnic and socioeconomic groups, HB 1546 is not designed to fully address underlying issues that lead to persistent gaps in access and participation in accelerated learning option courses. If gains in grade 10 CHS course enrollment are to be sustained, early preparation for advanced coursework will be paramount to reaching students that have not traditionally participated in accelerated learning option courses. This could involve discrete interventions such as course acceleration in middle school (Dougherty, Goodman, Hill, Litke, & Page, 2017) and ninth grade on-track initiatives (Office of Superintendent of Public Instruction, 2019d). However, it is more likely that closing gaps in CHS course enrollment and credit accrual will require a holistic approach to addressing socio-emotional and academic needs in elementary and middle school. In particular, socioeconomic status is highly predictive of academic achievement and attainment in Washington state and nationwide (Ratcliffe, 2015). Low academic progress early on leaves scarce time to catch up, such that efforts to prepare students for college-level work in grade 10 must rely heavily on students' middle and elementary school experiences.

7.2 Considerations for Future and Ongoing Policy Implementation

The combined findings of this dissertation provide early evidence to suggest that HB 1546 has begun to influence increases in CHS course enrollment. To strengthen impacts, state education leaders and legislators may consider how to support schools that are eligible for subsidies but that have no history of offering CHS courses. Examining the resources these schools have, such as partnerships with colleges and appropriately credentialed teachers, as well as some of the strengths and challenges of the students and communities they serve may identify appropriate policies, interventions, or uses of existing funds to support the development of successful and equitable CHS programs.

In addition, it could be useful to examine the efficiency of CHS subsidies. The state allocates funding based on schools' projections of how many students will take CHS courses. Between 2016/17 and 2017/18, only 37–38 percent of awarded credits were used (see table 3.1). While the state recoups the money it allocated for unused credits, this limits the potential of HB 1546 to improve participation among its targeted students in two ways. First, eligible schools that did not apply for subsidies could not access these unused credits. Instead, the state may consider ways to make these unused credits available to students who took CHS courses in eligible schools that were not awarded subsidies. Second, students' use of the CHS subsidies is restricted when they are in grades 9 and 10—they are ineligible regardless of their school's eligibility—and when they take more than 10 CHS credits in a school year. Allowing exceptions to these restrictions for students in underrepresented groups within eligible schools could help close equity gaps.

Along the same lines, it is important to consider HB 1546 in the context of other policies. New, more rigorous graduation credit requirements began taking effect in the 2018/19 school year. In addition, school accountability ratings are tied to participation in accelerated learning option courses in Washington state. Students may leverage CHS and other accelerated learning option courses in creative ways to fulfill new requirements, or they may end up having fewer opportunities to take accelerated learning option courses as their time in school is diverted to meeting other requirements. The interaction of policies like these could be useful to understand how to efficiently implement all policies to the maximum benefit of students. For example, eligible schools that do not have a CHS program and are also identified for comprehensive or targeted school improvement supports may be able to use both resources in concert to create better dual credit and dual enrollment options for students.

7.3 Considerations for Policy Outside Washington State

The features of HB 1546 along with the results of this study may inform policy generation, evaluation, and implementation in other states. A data-informed approach to policy design, a tiered priority funding mechanism to target the highest-need individuals, and methods to improve implementation efficiency and impact are features that have broad applications. Below, I describe how HB 1546 exemplifies a model approach or how its implementation challenges could inform improved policy designs.

7.3.1 Data-informed Approach to Policy Design

Effective in 2009, the Washington state legislature required annual reports of participation in dual credit programs (Wash Rev. Code § 28A.600.280, 2009). This data revealed disparities among student groups in accelerated learning options course-taking and motivated the creation of HB 1546 and other policies with the aim of sustaining upward trends in participation among all students and closing participation gaps for underrepresented students. Participation data identified patterns in which student groups were most underrepresented. However, high-quality data on why these student groups were underrepresented were not available at the time the policy was created. This left some blind spots for policy implementation, since it was unclear whether the best intervention for underrepresented students would be tuition subsidies if other challenges, such as academic readiness or the supply of qualified teachers were standing in the way of equitable representation in accelerated learning options courses.

Therefore, when designing a policy, it is valuable to go beyond one-dimensional comparisons of outcomes between student groups (e.g., male versus female, urban versus rural). At a minimum, policymakers should disaggregate top level results into multiple categories so that it is possible to make nuanced comparisons, such as outcomes for urban, black, high-achieving female students who have never experienced poverty compared to outcomes for rural, white, low-achieving male students who have experienced poverty. Using a regression approach can simplify complex comparisons across groups and allow for the study of how interactions among student characteristics influence outcomes. This may yield information that is helpful for policymaking. First, it can identify which student groups are most in need of support so that resources and programs can be directed where most needed. Then, it can reveal factors that appear to have the highest influence on outcomes (e.g., prior achievement, socioeconomic status) so that policy features can target high-leverage issues.

Similarly, it is important to systematically collect and use qualitative information about the strengths and challenges of the current system to design policies that efficiently prioritize and address barriers to the policy's goal. If possible, the use of strategic pilot tests to discover best practices when implementing the policy could accelerate positive results. If pilot testing does not occur, such as with HB 1546, evaluating implementation in schools or among student groups achieving the most and least success (see, for example, figures 5.5 and 6.3) may help define implementation elements needed to maximize the policy's impact. At a minimum, it is useful to understand the conditions under which the policy is designed for quick wins, such as making grade 10 students already enrolled in CHS courses eligible to earn college credit in them, and when the policy requires a long-haul investment before impacts become observable. This information helps set expectations around when and which outcomes are measured to show policymakers and the public how the policy is achieving its intended goals.

7.3.2 Prioritized Funding Based on Multiple Conditions

Washington state policymaker's understanding of the equity gaps in accelerated learning options course-taking led them to design a policy that prioritized limited state resources for students in underrepresented groups. A unique feature of HB 1546's tiered priority system is that it recognizes the interaction between experiencing poverty as an individual and attending a high-poverty school as a higher barrier to participating in accelerated learning options courses than either factor in isolation, thereby limiting funding to students who face both obstacles. This design principle could be extrapolated broadly in education policy and elsewhere. For example, after using data to identify the highest-need populations, a policy designed to re-engage students who have dropped out of high school may limit funding to students attending schools in neighborhoods that have high rates of poverty and low levels of education, then prioritize funding for students with disabilities within those schools.

7.3.3 Implementation Efficiency Considerations

The study of HB 1546 raises questions around efficiency in policy implementation. First, the component of the policy attached to funding did not yet produce observable impacts according to the regression discontinuity study. This component was also more difficult to implement. A multi-step and multi-stakeholder process was required for students to be able to take advantage of CHS subsidies. On the other hand, the unfunded extension of eligibility to earn college credit through CHS courses to grade 10 students was simple to implement and appeared to have a positive impact on CHS course participation among this student group. While this study cannot make a determination as to whether these results were due to policy design features, to the way these policy elements were evaluated, or to differences among students within the sample for the analysis of each policy element, it is worth considering the how much complex policy implementation features may limit a policy's application across targeted groups and, consequently, its impact.

7.4 Opportunities for Future Research

The primary limitation of this study's implications is that they are confined to an analysis of outcomes. The findings cannot explain how or why the patterns it uncovered exist. To do so, an implementation study that leverages a mixed methods or qualitative approaches could describe factors that facilitate or hinder access to and participation in CHS courses, particularly for schools that are eligible for CHS subsidies. With policy implementation data from interviews, focus groups, or surveys of district leaders, school administrators, teachers, counselors, and students, associations between implementation factors, school context and composition, and CHS outcomes can be analyzed. This line of inquiry could lead to the reporting and sharing of promising strategies that schools can embrace to improve and make more consistent CHS course-taking outcomes.

As previously stated, an RD design was not ideal for measuring impacts of CHS subsidies for schools eligible for Tier 3 subsidies since the probability of receiving subsidies was lower near the cutoff. Additionally, it may be hypothesized that the subsidies could have a different effect in schools with very high concentrations of poverty. By nature of the RD design, these schools were eliminated from the treatment group. Another approach, such as a matching design, may better describe policy impact among these schools.

Most importantly, this study was limited to data from K–12 sources. Future investigations on how the policy impacted postsecondary outcomes such as college enrollment, placement into college-level English and math courses, persistence, and time to degree should follow this dissertation. In particular, examining the effect of taking specific accelerated learning option courses on postsecondary outcomes could yield useful information for schools and districts to build, modify, or sustain certain accelerated learning options and for students and guidance counselors to plan high school course enrollment more strategically.

Ultimately, the findings from this dissertation show progress in the uphill battle to prepare students with diverse demographic and academic backgrounds for successful postsecondary experiences. More students are enrolling in accelerated learning option courses, progress which can, in the case of grade 10 enrollment in CHS courses, be causally linked to the implementation of HB 1546. Other results for students in schools eligible for CHS subsidies are consistently positive, but rarely statistically significant. This pattern should give policy implementers cautious optimism that outcomes are trending in the right direction, and motivation to consider ways to strengthen implementation that bring about more consistent positive impacts. Challenges to achieving equitable participation in accelerated learning options persist. Yet, this evidence shows that strategic policies and sustained efforts to remove barriers to participation may, in the long run, transform educational opportunities for presently underserved students.

References

Allen, D. (2010). *Dual enrollment: A comprehensive literature review & bibliography*. New York, NY: City University of New York Collaborative Programs, Research & Evaluation Unit.

Allen, D., & Dadgar, M. (2012). Does dual enrollment increase students' success in college? Evidence from a quasi-experimental analysis of dual enrollment in New York City. *New Directions for Higher Education*, *158*, 11–19. https://doi.org/10.1002/he.20010

Alston, P. (2018). *Report of the Special Rapporteur on extreme poverty and human rights on his mission to the United States of America* (A/HRC/38/33/Add.1). Retrieved from United Nations, Digital Library website: https://digitallibrary.un.org/record/1629536?ln=en

An, B. P. (2013). The impact of dual enrollment on college degree attainment: Do low-SES students benefit? *Educational Evaluation and Policy Analysis*, *35*(1), 57–75. https://doi.org/10.3102/0162373712461933

Bailey, T., & Karp, M. M. (2003). *Promoting college access and success: A review of credit-based transition programs*. Retrieved from Columbia University, Teachers College, Community College Research Center website: https://ccrc.tc.columbia.edu/publications/access-success-credit-based-transition.html

Baum, S., Ma, J., & Payea, K. (2013). *Education Pays 2013: The benefits of higher education for individuals and society*. Retrieved from College Board website: https://greenville.org/wp-content/uploads/2015/05/education-pays-2013-full-report.pdf

Bautsch, B. (2014). *The effects of concurrent enrollment on the college-going and remedial education rates of Colorado's high school students*. Retrieved from Colorado Department of Education, Department of Higher Education website: http://highered.colorado.gov/academics/concurrent/ConcurrentEnrollmentEffectsAnalysis_2014.pdf

Berger, A. R., Cole, S., Duffy, H., Edwards, S., Knudson, J., Kurki, A., … Nielsen, N. (2009). *Six years and counting: Fifth annual Early College High School Initiative evaluation synthesis report*. Retrieved from American Institutes for Research website: https://www.air.org/sites/default/files/downloads/report/ECHSI_Eval_Report_2009_081309_0.pdf

Berger, A., Turk-Bicakci, L., Garet, M., Song, M., Knudson, J., Haxton, C., … Stephan, J. (2013). *Early college, early success: Early College High School Initiative impact study*. Retrieved from American Institutes for Research website: https://www.air.org/sites/default/files/downloads/report/ECHSI_Impact_Study_Report_Final1_0.pdf

Blankenberger, B., Lichtenberger, E., & Witt, M.A. (2017). Dual credit, college type, and enhanced degree attainment. *Educational Researcher, 46*(5), 259–263. https://doi.org/10.3102/0013189X17718796

Bloom, H. S. (1999). *Estimating program impacts on student achievement using "short" interrupted time series* [Working paper]. Retrieved from MDRC website: https://www.mdrc.org/sites/default/files/full_92.pdf

Bollmer, J., Bethel, J., Garrison-Mogren, R., & Brauen, M. (2007). Using the risk ratio to assess racial/ethnic disproportionality in special education at the school-district level. *Journal of Special Education, 41*(3), 186–198. https://doi.org/10.1177/00224669070410030401

Borden, V. M., Taylor, J. L., Park, E., & Seiler, D. J. (2013). *Dual credit in US higher education: A study of state policy and quality assurance practices*. Chicago, IL: Higher Learning Commission. Retrieved from https://downloadna11.springcm.com/content/DownloadDocuments.ashx?aid=5968&Selection=Document%2Ce3823bc3-3c88-e211-ad6c-0025b3af184e%3B

Bragg, D. D., Kim, E., & Rubin, M. B. (2005, November). *Academic pathways to college: Policies and practices of the fifty states to reach underserved students*. Paper presented at the annual meeting of the Association for the Study of Higher Education, Philadelphia, PA. Retrieved from https://pdfs.semanticscholar.org/6cc0/61ec7ed92e2cf71718457cd740076a6adfe4.pdf

Burning Glass Technologies. (2014). *Moving the goalposts: How demand for a bachelor's degree is reshaping the workforce*. Retrieved from https://www.burning-glass.com/wp-content/uploads/Moving_the_Goalposts.pdf

Burns, H., & Lewis, B. (2000). Dual-enrolled students' perceptions of the effect of classroom environment on educational experience. *Qualitative Report, 4*(1), 1–10. Retrieved from https://nsuworks.nova.edu/tqr/vol4/iss1/7/

Carl D. Perkins Career and Technical Education Improvement Act of 2006, Pub. L. No. 109-270 § 109 Stat. 683 (2005–2006). Retrieved from https://www.congress.gov/bill/109th-congress/senate-bill/250/text

College Board. (2014). *Trends in college pricing 2014*. Retrieved from https://secure-media.collegeboard.org/digitalServices/misc/trends/2014-trends-college-pricing-report-final.pdf

Complete College America. (2014). *Four-year myth: Make college more affordable. Restore the promise of graduating on time*. Retrieved from ERIC database. (ED558792)

Cowan, J., & Goldhaber, D. (2015). How much of a "running start" do dual enrollment programs provide students? *Review of Higher Education, 38*(3), 425–460.

Crouse, J. D., & Allen, J. (2013). College course grades for dual enrollment students. *Community College Journal of Research and Practice, 38*(6), 494–511. https://doi.org/10.1080/10668926.2011.567168

Davis, E., Smither, C., Zhu, B., & Stephan, J. (2017). *Characteristics and postsecondary pathways of students who participate in acceleration programs in Minnesota* (REL 2017-234). Retrieved from U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Midwest website: https://ies.ed.gov/ncee/edlabs/regions/midwest/pdf/REL_2017234.pdf

Deussen, T., Hanson, H., & Bisht, B. (2017). *Are two commonly used early warning indicators accurate predictors of dropout for English learner students? Evidence from six districts in Washington state* (REL 2017-261). Retrieved from U.S. Department of Education, Institute of Education Sciences, National Center for Evaluation and Regional Assistance, Regional Educational Laboratory Northwest website: https://ies.ed.gov/ncee/edlabs/regions/northwest/pdf/REL_2017261.pdf

Diallo, A. (2017, November 16). Rural schools join forces to make college the rule rather than the exception: Cooperation among sparsely populated districts in Ohio fuels a successful push for college in a place where manufacturing jobs have disappeared. *The Hechinger Report*. Retrieved from https://hechingerreport.org/rural-schools-join-forces-make-college-rule-rather-exception/

Dougherty, S. M., Goodman, J. S., Hill, D. V., Litke, E. G., & Page, L. C. (2017). Objective course placement and college readiness: Evidence from targeted middle school math acceleration. *Economics of Education Review, 58*, 141–161. https://doi.org/10.1016/j.econedurev.2017.04.002

Edmunds, J. A., Unlu, F., Glennie, E., Bernstein, L., Fesler, L., Furey, J., & Arshavsky, N. (2017). Smoothing the transition to postsecondary education: The impact of the Early College Model. *Journal of Research on Educational Effectiveness, 10*(2), 297–325. https://doi.org/10.1080/19345747.2016.1191574

Edwards, L., Hughes, K. L., & Weisberg, A. (2011). *Different approaches to dual enrollment: Understanding program features and their implications*. Retrieved from Columbia University, Teachers College, Community College Research Center website: https://ccrc.tc.columbia.edu/media/k2/attachments/dual-enrollment-program-features-implications.pdf

Eells, W. C. (Ed.). (1940). *American junior colleges*. Retrieved from Wayback Machine website: https://ia802606.us.archive.org/21/items/americanjuniorco013559mbp/americanjuniorco013559mbp.pdf

Estrada, P. (2014). English learner curricular streams in four middle schools: Triage in the trenches. *Urban Review, 46*(4), 535–573. Retrieved from https://link.springer.com/article/10.1007/s11256-014-0276-7

Every Student Succeeds Act of 2015, Pub. L. No. 114-95 § 114 Stat. 1177 (2015–2016). Retrieved from https://www.congress.gov/bill/114th-congress/senate-bill/1177

Exby, H. D. (2014). *The lived experience of high school instructors teaching concurrent enrollment courses* (Doctoral dissertation, Colorado State University). Retrieved from https://mountainscholar.org/bitstream/handle/10217/83738/Exby_colostate_0053A_12469.pdf?sequence=1

Fan, J., & Gijbels, I. (1996). *Local polynomial modeling and its applications*. London, UK: Chapman & Hall.

Ganzert, B. Y. (2010). *The effects of dual enrollment credit and Huskins program credit on college readiness* (Doctoral dissertation, Appalachian State University). Retrieved from https://libres.uncg.edu/ir/asu/f/Ganzert,%20Bartlett_2010_Dissertation.pdf

Gewertz, C. (2016, September 7). Are dual-enrollment programs overpromising? *Education Week, 36*(3), pp. 1, 12–13. Retrieved from https://www.edweek.org/ew/articles/2016/09/07/are-dual-enrollment-programs-overpromising.html

Giani, M., Alexander, C., & Reyes, P. (2014). Exploring variation in the impact of dual-credit coursework on postsecondary outcomes: A quasi-experimental analysis of Texas students. *High School Journal*, *97*(4), 200–218.

Gilbert, E. (2017, November 5). How dual enrollment contributes to inequality. *Chronicle of Higher Education, 64*(11). Retrieved from https://www.chronicle.com/article/How-Dual-Enrollment/241668

Global Partnership for Education. (2018). *The benefits of education*. Retrieved from https://www.globalpartnership.org/education/the-benefits-of-education

Greenberg Motamedi, J. (2015). *Time to reclassification: How long does it take English learner students in Washington Road Map districts to develop English proficiency?* (REL 2015-092). Retrieved from U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Northwest website: https://ies.ed.gov/ncee/edlabs/regions/northwest/pdf/REL_2015092.pdf

Greenberg Motamedi, J., Cox, M., Williams, J., & Deussen, T. (2016). *Uncovering diversity: Examining the representation of English learners in special education in Washington state*. Retrieved from ERIC database. (ED570981)

Grubb, J. M., Scott, P. H., & Good, D. W. (2017). The answer is yes: Dual enrollment benefits students at the community college. *Community College Review, 45*(2), 79–98. https://doi.org/10.1177/0091552116682590

Hahn, J., Todd, P., & Van der Klaauw, W. (2001). Identification and estimation of treatment effects with a regression-discontinuity design. *Econometrica, 69*(1), 201–209. https://doi.org/10.1111/1468-0262.00183

Hanson, H., Bisht, B., & Greenberg Motamedi, J. (2016). *Advanced course enrollment and performance among English learner students in Washington state* (REL 2017-187). Retrieved from U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Northwest website: https://ies.ed.gov/ncee/edlabs/regions/northwest/pdf/REL_2017187.pdf

Haskell, R. E. (2016). The effects of dual-credit enrollment on underrepresented students: The Utah case. *International Journal of Economics and Finance, 8*(1), 144–165. https://doi.org/10.5539/ijef.v8n1p144

H.R. 1546, 64th Leg., Reg. Sess. (Wash. 2015). Retrieved from http://lawfilesext.leg.wa.gov/biennium/2015-16/Pdf/Bills/House%20Passed%20Legislature/1546-S2.PL.pdf

Iacus, S. M., King, G., & Porro, G. (2012). Causal inference without balance checking: Coarsened exact matching. *Political Analysis, 20*(1), 1–24. https://doi.org/10.1093/pan/mpr013

Imbens, G. W., & Lemieux, T. (Eds.). (2008). Special issue editors' introduction: The regression discontinuity design—theory and applications. *Journal of Econometrics, 142*(2), 611–614. https://doi.org/10.1016/j.jeconom.2007.05.008

International Baccalaureate. (n.d.). *About the IB.* Retrieved from https://www.ibo.org/about-the-ib

Jacob, R., Somers, M.-A., Zhu, P., & Bloom, H. (2016). The validity of the comparative interrupted time series design for evaluating the effect of school-level interventions. *Evaluation Review, 40*(3), 167–198. https://doi.org/10.1177/0193841X16663414

Jacob, R. T., Zhu, P., Somers, M.-A., & Bloom, H. (2012). *A practical guide to regression discontinuity*. Retrieved from MDRC website: https://www.mdrc.org/publication/practical-guide-regression-discontinuity

Jones, S. J. (2014). Student participation in dual enrollment and college success. *Community College Journal of Research and Practice*, *38*(1), 24–37. https://doi.org/10.1080/10668926.2010.532449

Kanno, Y., & Kangas, S. E. N. (2014). “I’m not going to be, like, for the AP”: English language learners’ limited access to advanced college-preparatory courses in high school. *American Educational Research Journal, 51*(5), 848–878. https://doi.org/10.3102/0002831214544716

Kanny, M. A. (2015). Dual enrollment participation from the student perspective. In J. L. Taylor & J. Pretlow (eds.), *Dual enrollment policies, pathways, and perspectives. New Directions for Community Colleges*, *2015*(169), 59–70. https://doi.org/10.1002/cc.20133

Karp, M. M. (2012). “I don’t know, I’ve never been to college!” Dual enrollment as a college readiness strategy. In E. Hoffman & D. Voloch (Eds.), *Dual enrollment strategies, outcomes, and lessons for school-college partnerships. New Directions for Higher Education, 2012*(158), 21–28. https://doi.org/10.1002/he.20011

Karp, M. M., Bailey, T. R., Hughes, K. L., & Fermin, B. J. (2004). *State dual enrollment policies: Addressing access and quality*. Retrieved from ERIC database. (ED484432)

Karp, M. M., Calcagno, J. C., Hughes, K. L., Jeong, D. W., & Bailey, T. (2008). *The postsecondary achievement of participants in dual enrollment: An analysis of student outcomes in two states.* Retrieved from Columbia University, Teachers College, Community College Research Center website: https://ccrc.tc.columbia.edu/publications/dual-enrollment-student-outcomes.html

Katz, S. N. (2006, March 10). The liberal arts in school and college. *Chronicle of Higher Education, 52*(27), B46.

Kim, J. (2008). *The impact of dual and articulated credit on college readiness and total credit hours in four selected community colleges: Excerpts from a doctoral dissertation literature review*. Retrieved from University of Illinois at Urbana-Champaign, College of Education, Office of Community College Research and Leadership website: https://occrl.illinois.edu/docs/librariesprovider4/dual-credit/impact-dual-credit.pdf

King, G., & Nielsen, R. (2019). Why propensity scores should not be used for matching. *Political Analysis, 27*(4), 435–454. https://doi.org/10.1017/pan.2019.11

Kuh, G. D., Gonyea, R. M., & Williams, J. M. (2005). What students expect from college and what they get. In T. E. Miller, B. E. Bender, J. H. Schuh, & Associates, *Promoting reasonable expectations: Aligning student and institutional views of the college experience* (pp. 34–64). San Francisco, CA: Jossey-Bass.

Lee, D. S., & Card, D. (2008). Regression discontinuity inference with specification error. *Journal of Econometrics, 142*(2), 655–674. https://doi.org/10.1016/j.jeconom.2007.05.003

Lerner, J. B., & Brand, B. (2006). *The college ladder: Linking secondary and postsecondary education for success for all students.* Washington, DC: American Youth Policy Forum.

Mangan, K. (2014, February 17). Is faster always better? As more high schools offer ways to earn college credit, some educators worry that students are being set up to fail. *Chronicle of Higher Education.*

Mayo, T. (2012). *Kentucky middle college high schools: Analysis of academic achievement and educational plans of middle college high school students in Kentucky* (Doctoral dissertation, University of Kentucky). Available from ProQuest Dissertations and Theses database. (UMI No. 3579271).

Middle College National Consortium. (n.d.). *Our history.* Retrieved from http://mcnc.us/about/our-history/

Miller, T., Kosiewicz, H., Tanenbaum, C., Atchison, D., Knight, D., Ratway, B., … Levin, J. (2018). *Dual-credit education programs in Texas: Phase II.* Retrieved from Texas Higher Education Coordinating Board website: http://reportcenter.thecb.state.tx.us/reports/data/dual-credit-education-programs-in-texas-phase-ii/

Miller, T., Kosiewicz, H., Wang, E. L., Marwah, E. V. P., Delhommer, S., & Daugherty, L. (2017). *Dual credit education in Texas: Interim report*. Retrieved from RAND Corporation website: https://www.rand.org/pubs/research_reports/RR2043.html

Mobley, K. (2014, October 23). Concurrent enrollment thriving in rural schools despite challenges [Blog post]. Retrieved from https://ccrscenter.org/blog/concurrent-enrollment-thriving-rural-schools-despite-challenges

Modarelli, B. J. (2014). *Intensive dual enrollment: Early credits or empty promises* (Doctoral dissertation, University of South Carolina). Retrieved from http://scholarcommons.sc.edu/etd/3027

Museus, S. D., Lutovsky, B. R., & Colbeck, C. L. (2007). Access and equity in dual enrollment programs: Implications for policy formation. *Higher Education in Review, 4*, 1–19.

National Conference of State Legislatures. (2014). *Accelerated learning options.* Denver, CO: Author.

New Mexico Legislative Finance Committee. (2017). *Dual credit: Funding and student outcomes*. Retrieved from https://nmlegis.gov/Entity/LFC/Documents/Program_Evaluation_Progress_Reports/progress%20report%20dual%20credit%20september%202017.pdf

North, T., & Jacobs, J. (2010). *Dual credit in Oregon: An analysis of students taking dual credit in high school in 2007–2008 with subsequent performance in college*. Eugene, OR: Oregon University System, Office of Institutional Research.

Odland, S. (2012, March 24). College costs out of control. *Forbes*. Retrieved from https://www.forbes.com/sites/steveodland/2012/03/24/college-costs-are-soaring/#398675e1f862

Office of Superintendent of Public Instruction. (2019a). *Data portal*. Retrieved September 8, 2019, from https://www.k12.wa.us/data-reporting/data-portal

Office of Superintendent of Public Instruction. (2019b). *Migrant and bilingual education* [Webpage]. Retrieved from https://www.k12.wa.us/student-success/equity-education/migrant-and-bilingual-education

Office of Superintendent of Public Instruction. (2019c). *Rural Education Initiative*. Retrieved from https://www.k12.wa.us/policy-funding/grants-grant-management/rural-education-initiative

Office of Superintendent of Public Instruction. (2019d). *Freshman success best practices and strategies* [Webpage]. Retrieved from https://www.k12.wa.us/student-success/support-programs/freshman-success/freshman-success-best-practices-strategies

Organization for Economic Co-operation and Development. (2016). *Population with tertiary education*. Retrieved September 25, 2019 from https://data.oecd.org/eduatt/population-with-tertiary-education.htm

Peterson, M., Anjewierden, J., & Corser, C. (2001). Designing an effective concurrent enrollment program. In P. Robertson, B. Chapman, & F. Gaskin, F. (Eds.), *Systems for offering concurrent enrollment at high schools and community colleges. New Directions for Community Colleges, 2001*(113), 23–32. https://doi.org/10.1002/cc.5

Pierson, A., Hodara, M., & Luke, J. (2017). *Earning college credits in high school: Options, participation, and outcomes for Oregon students* (REL 2017-216). Retrieved from U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Northwest website: https://ies.ed.gov/ncee/edlabs/regions/northwest/pdf/REL_2017216.pdf

Porter, J. (2003). *Estimation in the regression discontinuity model* [Working paper]. Retrieved from University of Santa Barbara, Department of Economics website: http://econ.ucsb.edu/~doug/245a/Papers/Estimation%20in%20RD%20Model.pdf

Pretlow, J., & Wathington, H. (2013). Access to dual enrollment courses and school-level characteristics. *Community College Journal of Research and Practice*, *37*(3), 196–204. https://doi.org/10.1080/10668926.2013.739513

Pretlow, J., & Wathington, H. D. (2014). Expanding dual enrollment: Increasing postsecondary access for all? *Community College Review*, *42*(1), 41–54. https://doi.org/10.1177/0091552113509664

Radunzel, J., Noble, J., & Wheeler, S. (2014). *Dual-credit/dual-enrollment coursework and long-term college success in Texas* [Issue brief]. Retrieved from ACT website: http://www.act.org/content/dam/act/unsecured/documents/DualCreditTexasReport.pdf

Ratcliffe, C. (2015). *Child poverty and adult success*. Retrieved from Urban Institute website: https://www.urban.org/sites/default/files/publication/65766/2000369-Child-Poverty-and-Adult-Success.pdf

Reardon, S. F., & Robinson, J. P. (2012). Regression discontinuity designs with multiple rating-score variables. *Journal of Research on Educational Effectiveness, 5*(1), 83–104. https://doi.org/10.1080/19345747.2011.609583

Reykdal, C. (2017). *Superintendent Reykdal's K–12 education vision and McCearly framework*. Olympia, WA: Office of Superintendent of Public Instruction.

Reykdal, K. (2018). *Dual credit program enrollment: Statewide and among academic acceleration grantees: Report to the Legislature* [Annual update]. Retrieved from Office of Superintendent of Public Instruction website: http://www.k12.wa.us/sites/default/files/public/legisgov/2018documents/2018-01-dualcreditenrollment.pdf

Robertson, P., Chapman, B., & Gaskin, F. (Eds.). (2001). *Systems for offering concurrent enrollment at high schools and community colleges* (Special Issue). *New Directions for Community Colleges, 2001*(113).

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Boston, MA: Houghton Mifflin Company.

Shapiro, D., Dundar, A., Ziskin, M., Yuan, X., & Harrell, A. (2013). *Completing college: A national view of student attainment rates-fall 2007 cohort*. Retrieved from National Student Clearinghouse Research Center website: https://nscresearchcenter.org/wp-content/uploads/NSC_Signature_Report_6.pdf

Smith, D. (2007). Why expand dual-credit programs? *Community College Journal of Research and Practice, 31*(5), 371–387. https://doi.org/10.1080/10668920600932884

Snyder, T. D., de Brey, C., & Dillow, S. A. (2019). Table 104.10. Rates of high school completion and bachelor's degree attainment among persons age 25 and over, by race/ethnicity and sex: Selected years, 1910 through 2017. In *Digest of Education Statistics 2017* (NCES 2018-070, pp. 37–39). Retrieved from U.S. Department of Education, National Center for Education Statistics website: https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2018070

Southern Regional Education Board. (2011). *New measures, new perspectives: Graduates' time- and credits-to-degree in SREB states* [Research brief]. Retrieved from https://www.sreb.org/sites/main/files/file-attachments/11e08_res_brief.pdf

Stock, J. H., & Yogo, M. (2005). Testing for weak instruments in linear IV regression. In D. W. K. Andrews & J. H. Stock (Eds.), *Identification and inference for econometric models: Essays in honor of Thomas Rotherberg* (pp. 80–108). New York, NY: Cambridge University Press.

Struhl, B., & Vargas, J. (2012). *Taking college courses in high school: A strategy guide for college readiness—the college outcomes of dual enrollment in Texas*. Retrieved from ERIC database. (ED537253)

Swanson, J. L. (2008). *An analysis of the impact of high school dual enrollment course participation on post-secondary academic success, persistence and degree completion* (Doctoral dissertation, University of Iowa). Retrieved from http://nacep.org/wp-content/uploads/2010/02/Dissertation-2008-Joni-L.-Swanson.pdf

Taylor, J. L. (2015). Accelerating pathways to college: The (in)equitable effects of community college dual credit. *Community College Review, 43*(4), 355–379. https://doi.org/10.1177/0091552115594880

Thomas, N., Marken, S., Gray, L., & Lewis, L. (2013). *Dual credit and exam-based courses in U.S. public high schools: 2010–11* (First Look, NCES 2013-001). Retrieved from U.S. Department of Education, National Center for Education Statistics website: https://nces.ed.gov/pubs2013/2013001.pdf

Tinto, V. (1993). *Leaving college: Rethinking the causes and cures of student attrition* (2nd ed.). Chicago, IL: University of Chicago Press.

Tobolowsky, B. F., & Ozuna, T. (2016). (Un)intended consequences: The first-year college experience of students with dual credits. *Journal for the First-Year Experience & Students in Transition, 28*(1), 27–47.

Umansky, I. M. (2015, April). *The impact of English learner status on academic course-taking*. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.

U.S. Department of Education. (2016). *Advanced Placement test fee program* [Webpage]. Retrieved from https://ed.gov/programs/apfee/index.html

U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, What Works Clearinghouse. (2017a). *WWC Intervention Report: Dual enrollment programs.* Retrieved from https://ies.ed.gov/ncee/wwc/Docs/InterventionReports/wwc_dual_enrollment_022817.pdf

U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, What Works Clearinghouse. (2017b). *What Works Clearinghouse standards handbook, version 4.0*. Retrieved from https://ies.ed.gov/ncee/wwc/Docs/referenceresources/wwc_standards_handbook_v4.pdf

U.S. Department of Education, National Center for Education Statistics. (2019a). *Common Core of Data (CCD)*. Retrieved from https://nces.ed.gov/ccd/

U.S. Department of Education, National Center for Education Statistics. (2019b). *School Courses for the Exchange of Data (SCED)*. Retrieved from https://nces.ed.gov/forum/sced.asp

Wang, X., Chan, H.-y., Phelps, L. A., Washbon, J. I. (2015). Fuel for success: Academic momentum as a mediator between dual enrollment and educational outcomes of two-year technical college students. *Community College Review, 43*(2), 165–190. https://doi.org/10.1177/0091552115569846

Wash. Rev. Code § 28A.230.140 (2011). Retrieved from https://app.leg.wa.gov/RCW/default.aspx?cite=28A.230.130

Wash. Rev. Code § 28A.320.195 (2013). Retrieved from https://app.leg.wa.gov/RCW/default.aspx?cite=28A.320.195

Wash. Rev. Code § 28A.320.196 (2015). Retrieved from https://app.leg.wa.gov/RCW/default.aspx?cite=28A.320.196

Wash. Rev. Code § 28A.600.280 (2009). Retrieved from https://app.leg.wa.gov/rcw/default.aspx?cite=28A.600.280

Wash Rev. Code § 28A.600.290 (2015). Retrieved from https://app.leg.wa.gov/RCW/default.aspx?cite=28A.600.290

Wash. Rev. Code § 28A.600.300–400 (1990). Retrieved from http://app.leg.wa.gov/rcw/default.aspx?cite=28A.600.300

Wash. Rev. Code § 28B.10.053 (2012). Retrieved from http://apps.leg.wa.gov/rcw/default.aspx?cite=28B.10.053

Washington Student Achievement Council. (2015). *2015 Roadmap report: Measuring our progress*. Retrieved from https://www.wsac.wa.gov/sites/default/files/2015.Roadmap.Report.pdf

Washington Student Achievement Council. (2016). *Dual credit report*. Retrieved from https://www.wsac.wa.gov/sites/default/files/2016.10.07.WSAC.Dual%20Credit%20Report.pdf

Wechsler, H. S. (2001). *Access to success in the urban high school: The middle college movement.* New York, NY: Teachers College Press.

Western Interstate Commission for Higher Education. (2006). *Accelerated learning options: Moving the needle on access and success. A study of state and institutional policies and practices*. Retrieved from https://www.wiche.edu/info/publications/Accelerated_Learning_Options.pdf

Whealdon, C., & Ghahremani, L. (2018). *Celebrating the power of bilingualism. Community organizing and advocacy for English learner and multilingual student success in South King County and Washington State: Demographics, wins, and future policy solutions*. Retrieved from Community Center for Education Results, Road Map Project website: https://roadmapproject.org/resources/celebrating-the-power-of-bilingualism/

Wong, V. C., Cook, T. D., & Steiner, P.M. (2015). Adding design elements to improve time series designs: No Child Left Behind as an example of causal pattern-matching. *Journal of Research on Educational Effectiveness, 8*(2), 245–279. https://doi.org/10.1080/19345747.2013.878011

Zimmerman, S. (2012). Double-dipping for course credit. *Phi Delta Kappa, 93*(6), 38–41. https://doi.org/10.1177/003172171209300609

Zinth, J. (2016a). *Early college high schools: Model policy components* [Policy analysis]. Retrieved from Education Commission of the States website: https://www.ecs.org/wp-content/uploads/Early_College_High_Schools-__Model_policy_components.pdf

Zinth, J. D. (2016b). *Dual enrollment: How states fund participating high schools* [50-state comparison]. Retrieved from Education Commission of the States website: http://ecs.force.com/mbdata/MBQuestRTL?Rep=DE1510

Zinth, J. D. (2016c). *Dual enrollment: How states fund participating postsecondary institutions* [50-state comparison]. Retrieved from Education Commission of the States website: http://ecs.force.com/mbdata/MBQuestNB2?Rep=DE1511

Appendix A. Institutional Review Board Approval

This study includes human subjects and was approved with exempt status by the University of Alaska Fairbanks Institutional Review Board on October 8, 2018. The approval letter is shown on the following page.

UAF
UNIVERSITY OF ALASKA FAIRBANKS

(907) 474-7800
(907) 474-5444 fax
uaf-irb@alaska.edu
www.uaf.edu/irb

Institutional Review Board

909 N Koyukuk Dr. Suite 212, P.O. Box 757270, Fairbanks, Alaska 99775-7270

October 8, 2018

To:	Amy Vinlove, Ph.D. Principal Investigator
From:	University of Alaska Fairbanks IRB
Re:	[1329638-1] Early impacts of policies to expand access and participation in dual credit and dual enrollment courses in Washington state

Thank you for submitting the New Project referenced below. The submission was handled by Exempt Review. The Office of Research Integrity has determined that the proposed research qualifies for exemption from the requirements of 45 CFR 46. This exemption does not waive the researchers' responsibility to adhere to basic ethical principles for the responsible conduct of research and discipline specific professional standards.

Title:	Early impacts of policies to expand access and participation in dual credit and dual enrollment courses in Washington state
Received:	October 3, 2018
Exemption Category:	2
Effective Date:	October 8, 2018

This action is included on the November 7, 2018 IRB Agenda.

Prior to making substantive changes to the scope of research, research tools, or personnel involved on the project, please contact the Office of Research Integrity to determine whether or not additional review is required. Additional review is not required for small editorial changes to improve the clarity or readability of the research tools or other documents.

Appendix B. Supplementary Information

This appendix provides a visual that summarizes the conceptual model for the HB 1546 policy. It may be used to guide both ongoing policy implementation and future evaluations. A detailed discussion of the model appears in chapter 3.

Table B1. Conceptual Context for Dual Credit and Dual Enrollment Programs and Policies in Washington State

Resources	**Strategies and activities**	**Outputs**	**Short- and intermediate-term outcomes**	**Long-term impacts**
State • Policies • Funding • Evaluation Schools • Counselors • Credentialed teachers • Funding Colleges • Instructors • Location • Technology infrastructure • Funding Families • Supportive and informed • Financial contribution to student costs	Increase availability and quality of dual credit and dual enrollment programs by • funding the creation and expansion of secondary-postsecondary partnerships • funding high schools to create and expand dual credit and dual enrollment programs • prioritizing increasing offerings for underrepresented students Increase enrollment by: • disseminating information and provide guidance to students and families • automatically enrolling students in advanced courses based on test scores • funding tuition, fees, supplies, books, and transportation for low-income students	Number of schools receiving funding Amount of funding distributed Number of students enrolled in dual credit and dual enrollment courses Number of underrepresented students enrolled in dual credit and dual enrollment courses Number and variety of dual credit and dual enrollment course options Number of secondary-postsecondary partnerships Number of secondary and postsecondary faculty teaching dual credit or dual enrollment courses	Participation in dual credit and dual enrollment courses increases Gaps in participation for underrepresented students decrease Academic engagement and rigor improves as measured by grades, test scores, attendance, and discipline records High school graduation rates increase The cost and time required to earn a postsecondary degree decreases Postsecondary enrollment and completion rates increase	Citizens enter careers with family-sustaining wages Citizens generate higher tax revenues and economic growth Public health and safety improve State workforce meets industry needs

Assumptions and external factors

- Increases in the costs of higher education and the benefits of a higher degree will motivate students to enroll in accelerated learning courses
- Education systems have capacity to create and expand dual credit and dual enrollment programs
- Students meet eligibility criteria, and are academically prepared and motivated to take accelerated learning courses, and do not have work, family, or extracurricular commitments preventing them from enrolling in dual credit or dual enrollment courses